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THE SCHISEOPHONE.

IT is of a vital importance in certain industries to be able to discover the flaws that exist in the interior of blocks of metal, and which, at a given moment, may put the security of a piece of work seriously in jeopardy. Hardened chrome steel shells, for example, present numerous centers of tension. The molecules, irritated against each other (so to speak) by the tempering, tend to separate and to leave spaces between them. Shells with such an internal structure are worthless, and their point breaks against the armor plate that they are intended to traverse. In most cases, there is nothing to indicate such flaws, and the human ear is too dull an instrument to seize the differences in sounds given by the blow of a hammer, whether it be upon a perfect or a defective part. What has just been said about shells applies to all pieces of metal that are to be worked—gun tubes, axles, driving shafts, rails, etc.

Captain Louis De Place, professor of fortifications and of applied sciences at the School of Cavalry, has had recourse to the microphone, employed under certain conditions, for the detection of vacuities in metals. His apparatus, as will be seen, is an ingenious application of Dr. Hughes' balance. Captain De Place, combining the microphone with a mechanical striker and a sonometer, has produced an instrument which he calls a schiseophone (from Gr. σχίσις, "fissure," and φωνή, "sound" or "voice"), which permits of recognizing the difference in sound given by the striker, whether it strikes a perfect or an imperfect part.

The diagram in Fig. 4 shows the operation of the apparatus in the verifying room and the listening chamber represented in Fig. 1. At B we have the block to be examined, and in which we shall suppose that there is a flaw, *t*. A microphone of annular construction and of special form is traversed by the striker, F, which is actuated by a very simple mechanism (not figured) that gives it an alternate to and fro motion. A battery, P, is placed in the circuit of the microphone and of an inducting bobbin, B, fixed to the zero point of a graduated rule, R R'. Upon this latter moves an induced bobbin in whose circuit there is a pair of telephones provided with a bow that permits of fixing them upon the head.

It will now be understood that if the striker hits a perfect part such as *p*, the induced bobbin being in contact with the inducting one, the telephones will render a certain sound that will continue to diminish in measure as the operator widens the space between the bobbins. At a given moment, perfect silence will be obtained. If the examination be continued with the mechanical striker, and the latter hits at *p'*, a place where there is a flaw such as *t*, the interior vacuity will form a sounding box, the sound will increase, the microphone will again cause the resistance of the external circuit to vary, and the sound will be re-established in the telephones. The internal flaw will therefore be made known.

The schiseophone is inclosed in a box having four compartments which contain (Fig. 2): (1) the audiometer and its bobbins; (2) the telephones; (3) the striker and its microphone; and (4) six dry elements of the De Place system. These elements are in threes in tension, and a commutator upon the cover permits of changing the batteries every quarter of an hour in order to prevent polarization. The special absorbent discovered by Captain De Place, and called *melasine* by him, presents no internal resistance. It does not dry up, prevents climbing salts, and keeps the zincs in a permanently clean state. Recently, as well known, the occurrence of fissures in the main shaft of one of our cruisers retarded her entrance into service. This accident is not the first one, and the Chamber and public opinion were justly aroused to the idea that such a thing might occur during a mobilization, and thus paralyze the defense. With the schiseophone, it is an easy matter to examine main shafts every month. The fissures are internal before making their appearance upon the surface.

Some experiments were recently made at Ermont, the stock depot of the Company of the North. The schiseophone was kept in operation for a whole week, showing the company's engineers the internal flaws in rails. The location of the flaws was at once marked with red paint. In the afternoon, the rails were broken by a power hammer at the places indicated, and, in every instance, the breakage brought fissures of more or less importance to light.

In order to get proper indications from this instrument, it is important that the same operator shall always have the telephones, and that the apparatus be so maneuvered as to permit the striker to rebound upon the metal.

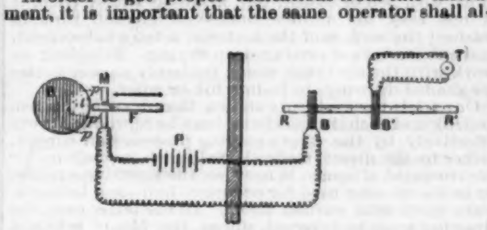


FIG. 4.—DIAGRAM OF THE APPARATUS.

Finally, in practice, it is preferable not to draw back the induced bobbin until perfect silence is obtained, but to allow a slight sound to remain in the telephone. It is the increase of such sound that reveals the internal flaw.

It will be easily conceived that it is of prime importance for railway companies to have none but sound rails. The defective ones break and cause derailments, which, aside from the personal accidents that accompany them, prove very expensive both on account of the indemnities to be paid and of the deterioration of the *materiel*. The schiseophone provides a remedy for this.—*La Nature.*

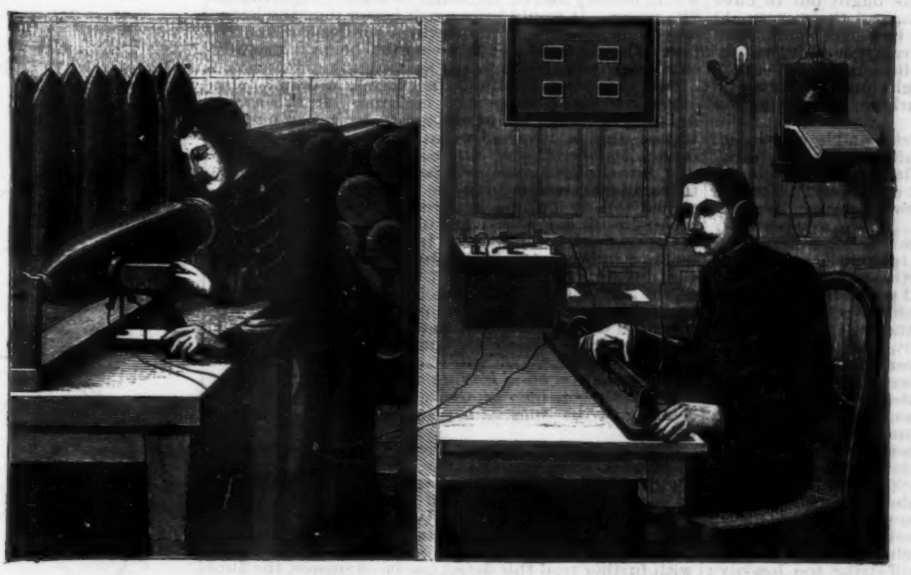


FIG. 1.—THE SCHISEOPHONE—VERIFYING AND TELEPHONE ROOMS.

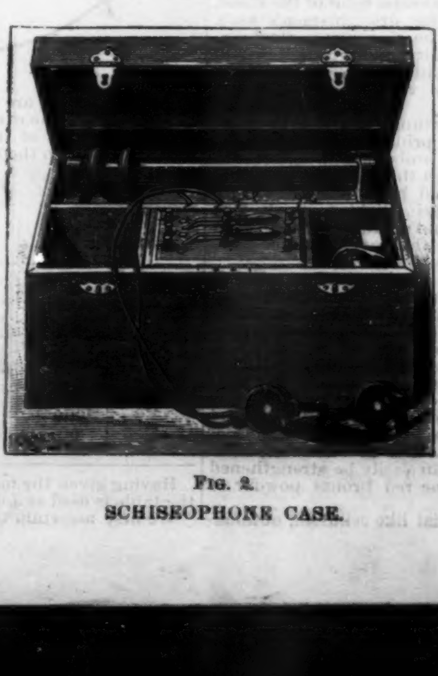


FIG. 2.
SCHISEOPHONE CASE.

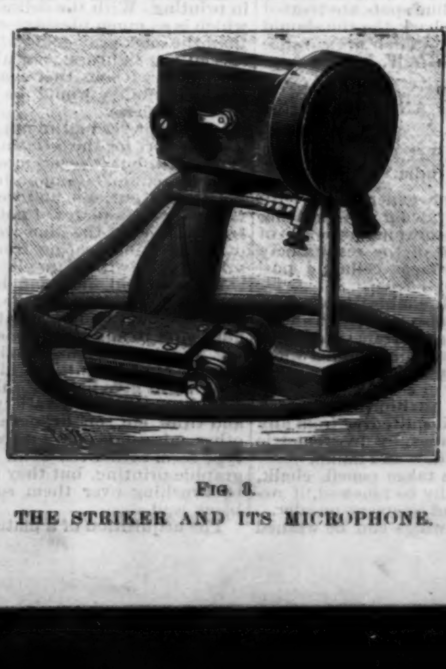


FIG. 3.
THE STRIKER AND ITS MICROPHONE.

HOW TO HAMMER CIRCULAR SAWS.

ON this subject J. H. Miner, of Baton Rouge, La., speaks as follows: The saw being the life of your mill, keep it in good condition. The chief element of this is in hammering and keeping the saw straight and true. The former we will term tension, which applies to keeping the saw open to accommodate the centrifugal force applied by its speed. The latter, straightening, applies to keeping the plate true and free from lumps. Saw hammering is a peculiar art, and accomplished by but few to any degree of perfection, simply from the many fogy ideas advanced by men, some of whom boast of their 20 years' experience. I have stood for 10 years at the lever, watching closely every so-called peculiarity of the saw.

The first thing is to straighten your saw. This is done on a wooden, firm, end-grain block or leather padded anvil. All mill saws dish more or less from the log, and are full on that side. It is necessary to lean the saw until the center sags so that it will appear as straight as possible, then with a 20-inch straight edge mark all the full places, watching closely just outside of the collar. Near the rim apply the straight edge at right angles in several positions; it is best to use say a 12-inch straight edge on the rim, as you can get closer to the teeth, mark your saw with chalk or hard soap, on the rim, when you find places to show straight one way, but high the other way; make a long mark directly in line with the straightest way. This indicates a twist, and will, in all cases on the rim extend toward the center of the saw. When the 20-inch straight edge is applied on the radius (from center to rim), such a place will not show, but take the 12-inch and apply across this line, and you will find it to be high. If there is a twist, it will be higher on the extreme edge. The straight pene hammer must be used on such places, the straightway of the hammer directly on the straightest way of the saw, which is toward the center. As the extreme edge is the highest, nearly all the blows must be applied there, care being taken not to go too far in. A twist showing six inches is often removed by hammering only on the rim. Twisted places are sometimes found at the center when the saw is dished.

Having laid off the saw, go to the block and strike one blow on every mark with the round face of the hammer, using the long face on the long marks. The first operation may dish the saw in the other way, which, if not too much, shows good work. Don't rub out your marks, and when the other side is laid off, notice if any of the marks correspond; if so, too heavy a blow was applied; in this way the heft of blows can be determined. Work on both sides of the saw, getting the rim as true as possible and leave it leaning a trifle to the log. This constitutes straightening. If your saw's tension is nearly right it will now run much better, but this is not always the case. I will add here that before attempting to straighten a saw as described, a careful inspection must be made. All saws get long or loose on the rim by use, and it is no common thing among small mills to find saws so loose on the rim as to form a twist or winding position; if not quite so loose, it will not be winding, but may appear nearly straight with the rim very flimsy, while the center will be as stiff as a board. In short, all such saws are stiff in the center and will not give, and must be tensioned before straightening.

This tensioning is done by stretching the saw nearer the center on an anvil with firm blows, regardless of the lumps in the saw. First, strike a circle line one-half way the radius, then two lines two inches apart below this, and one above, four lines in all. Hammer the two center lines first on both sides of the saw, but if it is very loose on the rim, it will often require four to six lines; in such cases the lines can be closer together. Never go nearer the rim than one-third the radius, and not much closer to the center. Keep this in view. The one-half way part of the saw must be the more open. A saw open too near the center will not run at all in many cases. After giving your saw some

tension, nine times out of ten your twisted saw, to your surprise, will show up straight. Sometimes a saw gets twisted through accident; such saws will show the center a little loose, and when they do, take the twisted saw to the block with a long pene, as stated. High-speeded saws require to be more open in the center, many of them dishing through with a snap. A saw too open will heat in the center and crowd from the log, while a saw too loose on the rim will snake and assume a complete wind or twist when a little hot on the rim. In such cases the center has to run hot in order to get anything like work out of the saw. A saw too open in the center is stiffened by hammering the rim, not nearer than two inches of the teeth; very little work on the rim will change a saw. When the saw has about the right spring, straighten it up on the block; then a trial will determine its tension. If the saw will not screw up true, the collar should be turned. If a saw is to remain on the mandrel, it may be papered if the collars dish it.

It is very essential that unequal tension be corrected in a saw that runs at a high or even moderate speed. Not one man in fifty knows anything about this, to say nothing of how to remove it.

Unequal tension is this: One part of the saw being tighter or more open than the other. I could write a volume on this important part of the saw's life. Now, to remove it, and in the simplest way, screw the saw up on the mandrel, take hold of the tail of the saw with the right hand (if it is a right hand mill), and spring the saw all you can to you, and at the same time apply the long straight edge and notice closely the opening. Apply the straight edge say every six inches, moving the saw and noticing the variation in light. You will find some places spring more, while others remain nearly to the straight edge; mark these places plainly. Now go on the outside of the saw, having everything free, so you can spring the saw, except the guide pins, which must be close to the saw. On this side mark the variations as before. If your saw has a loose place, you will find that it stood off more on both sides at that place. A tight place will stand off less and alike on both sides. In simpler words, loose places appear as though the plate was very thin, while tight places appear thick because they stand closer to the straight edge on both sides of the saw, loose places the farthest away. An open place on one side which shows high on the other indicates a lump; such a saw is not true, and must be taken to the block and trued up.

To remove loose places, hammer near the rim opposite such a place. Tight places are stretched right where they show it. For practical purposes, the saw should show very nearly the same spring all around. Always test both sides, and when even a slight variation is found it should be removed, then, if the saw is too open or too stiff, treat the center or rim a little on the anvil.

The fogy method is to always hammer a saw on the anvil, striking it as heavily as possible. When a saw requires a little straightening, it is mostly on the rim (the outlet of the saw); if this is done on the anvil, what is the result? Lumps partly beaten down, with all the tension gone; then the hammerer goes to the center to overcome just what he ought not to have done. A few blows on the block, and the saw would have retained its tension—been in better shape with ten times less work. No man can remove a twist in this way, directly on the rim. I have noticed over fifty such men, and they never get right up to the rim of a saw. Why? Because it will curl up, every time, on the anvil.

Test this with a piece of sheet iron, and be convinced. The tinner, iron and copper smith are sensible men; they have their copper or mallet hammer and a smooth block to straighten their work on. Why? Because only a blow or two on an anvil would stretch it into a wind, and then they are done. The saw is precisely the same way, and it remains only a question of time that the saw will be unequally tensioned, and then it is done. A man that knows anything about tension in a saw will take care of that vital part. Take a dished saw that requires only a few light blows near the collar, on the block. What does the fogy do? Stretch the rim, "pulling the dish" out, and a lot of other foolish things. A saw too open requires the rim stretched, but never a dished saw. Another idea is to hammer in lines from the center to the rim, only to result in tight and loose lines, and to buckle the saw. A man of gumption ought to know better than this, and this is the cause of many fractured saws. Others' theories are, that when a saw is sprung it must be sprung more to get the lump back. My idea is, if it is sprung it ought not to be, and should be gotten back without additional stretching, namely: The block.

Small saws are treated precisely as larger ones, but much more mildly. An expert changing from a thick saw to a thin one invariably will strike too heavily; great care must be exercised. They require but little tensioning, and should be stiff. Blue spots are treated on the block, and when they come back the rim should be stretched opposite such a place. Their appearance continually indicates a loose place.—*N. W. Lumberman.*

CELLULOID AS A DRAWING AND PRINTING MATERIAL.

By Colonel J. WATERHOUSE, B.S.C., Assistant Surveyor-General of India.

I HAVE lately been trying some experiments with celluloid films as a material for drawing and printing upon in connection with the photographic processes of reproduction, and a brief account of the results may not be uninteresting. The advantages celluloid possesses as a drawing material are:

1. Its great translucency, which enables tracings to be very easily made upon it, and also renders it an excellent material for being used as a transparency or transmitted positive or negative for photographic printing. The absence of all grain makes it much better for these purposes than paper or cloth.

2. Its impermeability to and unabsorptiveness of water or moisture, which make it quite free from any tendency to be affected like paper by hygrometric changes, or to be attacked by mildew and damp.

3. The fine matt surface, which takes pencil, chalk, or ink very readily, and can easily be renewed, if necessary, by graining with fine sand or emery powder.

4. The facility with which drawings can be washed off and renewed for purposes of correction or for making new drawings. The surface can easily be kept clean and free from dirt.

I have tried the films as obtained from America, in three thicknesses, the [illegible], [illegible], and [illegible] of an inch. The first is about the thickness of thin paper, and is almost free from color; the second, which seems to be the kind in ordinary use for negatives, etc., is about the thickness of a sheet of stout writing paper, and shows a light buff color if laid on white paper; the third is about the thickness of an ordinary playing card, and shows a strong buff color over white paper.

On account of its freedom from color and great flexibility, which would permit of its being rolled without damage, the thinnest kind would probably be found the most suitable for drawing upon; but as the surface of the thin sample sent me was not so evenly grained as the others, I used the medium kind for the trials. It was found that a soft black lead pencil worked very pleasantly on the matt surface, and gave a fair opacity of line when viewed through the film, so that pencil drawings on this material might be copied in fac simile very easily by various photographic processes. Black chalk, also, works very well, and gives more opacity in the lines than lead pencil does. The softer kinds work better than the hard. With the latter, as with hard lead pencils, there is a tendency to make lines which polish the surface and render it transparent when viewed through the film.

Indian ink drawings in line can be made with perfect fineness and delicacy, either on the matt or polished films, with pen or brush; but, as far as I have tried, it is not easy to produce shaded or colored tints in washes; the surface of the material is too unabsorbent, and cut shades are produced on drying. Stippling or work with the air brush would probably answer better for shaded drawings in Indian ink or color.

Our trials have already shown that drawings in pen and ink and in chalk on celluloid can be reproduced very effectively by the photo-etching processes on copper, either by the direct methods, in which asphaltum or bichromated albumen is used as the sensitive surface, or in the manner used for ordinary half-tone heliogravure work with carbon tissue. In the latter case, the drawing must be reversed, unless the film of celluloid is thin enough to allow the drawing to be printed with sufficient sharpness through the film. The drawings would also be suitable for reproduction by certain of the block processes now in use, and blocks could be produced directly from the artists' drawings. For all fac-simile work, negatives could easily be obtained, if necessary, by contact printing on dry plates.

The drawing can, in fact, be reproduced by any of the photographic processes now used for reproducing tracings; and as the material is perfectly free from all inequality of grains, is sold in large sheets, and will soon be available in continuous rolls, it seems likely that it might well replace tracing cloth or paper, for all copying or tracing purposes, and especially for tracings to be copied by photography.

The cost of the celluloid sheets, in any case, is not great, and if not required to be kept, the drawings can be washed off, and the same materials used over and over again. For sketching purposes the celluloid would be very useful, and could be made up into blocks like paper. It would keep much better than the latter in a damp climate. For drawings for decorative purposes, the material could, no doubt, be also usefully employed.

For preparing factitious negatives, celluloid also offers great advantages and facilities. In this way a drawing in Indian ink or other pigment can at once be turned into a reversed negative suitable for photo-mechanical printing by the collotype processes, or by any of the block processes depending on a direct photographic impression from the negative on a zinc plate, coated with asphaltum or chromated colloid. For this style of work, lamp or ivory black, with a little gum, is the best ink to draw with, Indian ink being rather inclined to become insoluble by keeping. As soon as the drawing is completed, it is evenly coated with a mixture of lamp black and gold size, as recommended by Major Gore, R.E., or with printing ink and turpentine with a little gold size, so that it may dry quickly. As soon as this is the case, but not before, the film is placed in water, which will at once clear the ink off the lines of the drawing, leaving them quite transparent against the opaque ground. For fine work a little clearing of the lines with a soft sponge may be necessary.

The new films have been tried as a printing surface, in place of stone or zinc plates, and have been found to answer fairly well, excepting that it is very difficult to keep the ground clear and white, and free from a slight dirty tint. Gum and gelatine, with various acids and with bichromate of potash, have been tried as "etching" preparations, but so far without effect. If with further trial this defect can be overcome, the films might be very valuable as a substitute for zinc or stone in printing. With the delicate cream color of the stone, which is so much pleasanter for draughtsmen's work than the dark gray color of the zinc plates, they possess all the lightness, portability, and infrangibility of the latter, without their liability to corrosion. Their ready flexibility would be of value in printing from curved surfaces.

I have not yet had an opportunity of trying the films as a support for the gelatine printing surface in collotype work, but it seems most probable that the thicker kind of celluloid ($\frac{1}{10}$ of an inch thick) would be suitable for this purpose, and would have the great advantage over glass plates of not being liable to break. The transparency of the films would admit of the sunning of the gelatine coating from the back, in exactly the same way as with glass plates.

The celluloid films can be printed on from stone or zinc fairly well, though the ink takes some time to become thoroughly dry. Printing from copper plates was not found to answer. Type can also be printed from, but the impressions obtained were somewhat weak, and the type indents the films very much; but further trial might give better results. Such prints from type would be useful in a variety of ways, for typing names and titles, etc., on heliogravure plates, and for many other miscellaneous purposes. The impressions from type seem rather too weak to use at once for photographic printing, but they can easily be strengthened by brushing over them some red bronze powder or black lead.

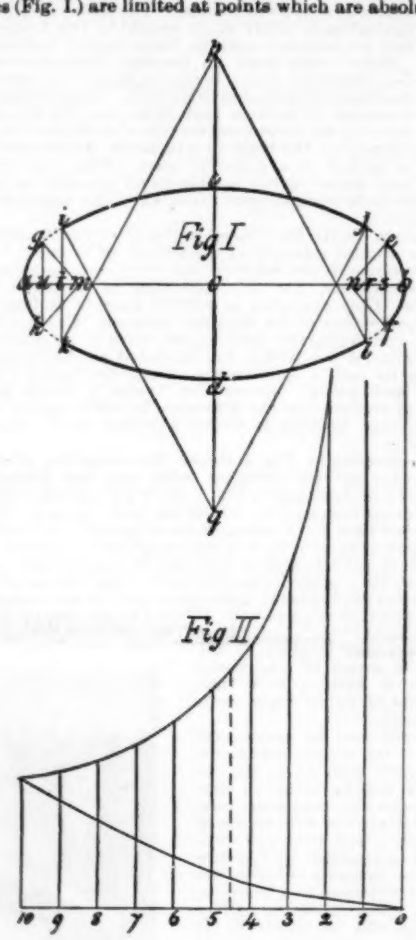
The acquisition of a material like celluloid, obtainable in sheets of large size and fine surface, which is practically transparent, inextensible, and unabsorbent of moisture, nor readily acted on by most acids (acetic acid attacks and dissolves it), is a great advance for all work connected with photography and printing, and it seems probable that we may see a very large extension of its use in these directions before long.—*Photo. News.*

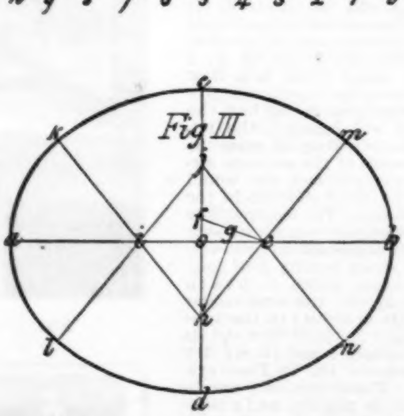
A TABLE FOR DRAWING ELLIPSES BY ARCS OF CIRCLES.

Constructed by FREDERIC R. HONEY, Ph.B., lecturer on perspective, Yale University and Smith College; instructor in geometrical drawing, New Haven public schools.

VARIOUS methods have been adopted for representing ellipses by arcs of circles, with more or less degree of accuracy. This method of drawing the curve is recommended, because if the centers be taken on the axes, symmetry is easily maintained when the figure is drawn in ink. A careful examination of the ellipse has shown that very nearly the whole of the curve may be constructed in this way, and that within certain limits it may be drawn *wholly* by arcs of circles.

The following table is so constructed that the four arcs (Fig. I.) are limited at points which are absolutely





correct, *i. e.*, they are determined from the equation to the curve. The extremities of these arcs, together with the vertices of the axis, thus give twelve points which conform to the theoretical locus:

THE TABLE.

	abs.	*abs.*	R	*r.*
$\frac{9}{10}$	....	....	....	0·829
$\frac{8}{10}$	....	....	....	0·676
$\frac{7}{10}$	....	....	....	0 542
$\frac{6}{10}$	0·8	0·9	1·451	0·392
$\frac{5}{10}$	0·8	0·9	1·700	0·288
$\frac{4}{10}$	0·8	0·95	2·081	0·181
$\frac{3}{10}$	0·8	0·95	2·724	0·112
$\frac{2}{10}$	0·8	0·975	4·040	0·051
$\frac{1}{10}$	0·8	....	8·010	0·022

Having given the major and minor axes of an ellipse, the table is used as follows:

We first ascertain the fraction which is obtained by

putting the length of minor axis for the numerator and that of the major axis for the denominator, and reduce it to one whose denominator is ten. Look down the vertical column on the left for this fraction, and the horizontal column following it will give all the information necessary for drawing the curve.

To illustrate (Fig. I.): The fraction is five-tenths, *i. e.*, the minor axis is one-half the major axis. In the horizontal column beginning with $\frac{5}{10}$ we find abscisses 0·8 and 0·9, which mean that we should lay off on the major axis on each side of the center distances equal to eight-tenths and nine-tenths of the semi-major axis. In the figure the semi-major axis is 1·5" long; therefore, lay off *o r* and *o t*, each equal to eight-tenths of 1·5", or 1·2"; also *o s* and *o u*, each equal to nine-tenths of 1·5", or 1·35". Under R is the figure 1·7; multiply this by the length of the semi-major axis, and lay off this distance (viz., 2·55") from the vertices, *c* and *d*, of the minor axis to the points *q* and *p*. With these points as centers and with a radius, *q c* (= *p d*), describe the arcs, *i c j* and *k d l*, limited by the double ordinates through the points, *r* and *t*, at the symmetrical points, *i*, *j*, *k*, and *l*. Under *r* is the figure 0·29; multiply this also by the length of the semi-major axis and lay off this distance (viz., 0·43") from the vertices, *a* and *b*, of the major axis to the points, *m* and *n*. With these points as centers and with a radius, *m a* (= *n b*), describe the arcs, *g a h* and *e b f*, limited by the double ordinates through the points, *u* and *s*, at the symmetrical points, *g*, *h*, *e*, and *f*. The parts of the curve represented by broken lines are drawn with the aid of the curved ruler.

Should the proportion between the minor and major axes of the ellipse which we desire to draw be not exactly represented in the left hand column, we must take for R and *r* figures which lie between those which are found in the table. Suppose the fraction to be $\frac{4\frac{1}{2}}{10}$ (or 4½-10), R may be taken the arithmetic mean between the figures 1·70 and 2·08, while *r* may be taken the arithmetic mean between 0·18 and 0·29. These figures will be accurate enough for all practical purposes, and, with a little practice, the draughtsman will have no trouble in readily determining them.

The table may be extended indefinitely in order to give the figures for R and *r* when the proportion between the axes is not exhibited by the fraction in the left hand column, as illustrated in the last paragraph. When great accuracy is required, we may use the accompanying curves (Fig. II.), the ordinates of which will give the lengths of R and *r* for any proportion which may exist between the axes. The lengths of the ordinates drawn with full lines are equal to those which we find in the table. If it be required to find R and *r* for a proportion of minor axis to major axis, say 4½ to 10, the lengths of the ordinates drawn with the broken lines midway between the ordinates 4· and 5· will give us the required measurements.

The table gives R and *r* to three places of decimals. In practice two places only are necessary. For small work one place is sufficient. The draughtsman is recommended to construct these curves accurately from the table, making the abscisses considerably longer than those which are laid off in Fig. II., which are contracted for lack of space. It will be seen that the ordinates for the *r* curve range from zero to unity; while those for the R curve range from unity to infinity. While the above description is rather lengthy, experience has proved that very satisfactory ellipses can be rapidly drawn in this way with a very moderate amount of practice.

When the proportion of the minor axis to the major axis lies between the limits, six-tenths and unity, we can use the well known construction for drawing an ellipse wholly by four arcs of circles. In Fig. III. the major and minor axes are respectively 3" and 2·4" long; therefore the fraction is eight-tenths. Multiply *r*, which in this case is 0·676, by 1·5, and the result is 1·01". From *b* and *c* the vertices of the major and minor axes lay off *b e* and *c f*, each equal to 1·01". Draw the straight line, *e f*, and bisect it at *g*; from *g* draw *g h* perpendicular to *e f*, intersecting the minor axis at *h*. Lay off *o i* equal to *o e* and *o j* equal to *o h*. Join *h e*, *j e*, *h i*, and *j i*, and produce these lines respectively to the points *m*, *n*, *k*, and *l*, making *e m*, *e n*, *i k*, and *i l* each equal to *e b* (= *i a*). With the radius, *e b*, and centers, *e* and *i*, draw the arcs, *m b n* and *k a l*. Also with the radius, *h c* (= *j d*), and centers, *h* and *j*, draw the arcs, *k c m* and *l d n*.

From the above geometrical construction it will be seen that *h c* is equal to *h m*; *i. e.*, the arcs, *k c m* and *n b m*, will connect at the point, *m*; also, since their centers, *h* and *e*, with the point, *m*, are in the same straight line, they have a common tangent at *m*, which, in practice, means that the curves join satisfactorily. Similar remarks apply to the points, *k*, *l*, and *n*.

150 TON ICE MAKING PLANT—LINDE SYSTEM.

WE publish this week illustrations of the ice making works and cold stores of the Linde British Refrigeration Company, at Lower Shadwell, London, England, for which and the following particulars we are indebted to *The Engineer*, London. These works, which are said to possess the most powerful refrigerating apparatus in the world, occupy the river frontage next to the new Shadwell Fish Market. They were erected in the year 1887 from the designs of Professor Linde, the architect being Mr. C. Dunch, of St. Clement's Lane, E. C.

The boiler house contains three Lancashire boilers, each 30 ft. long and 7 ft. diameter, and two sets of apparatus for producing distilled water for ice making purposes. The main building contains the steam engine and compressor room, a perspective view of which is shown in our page engraving, two large ice making rooms, each with apparatus for turning out 65 tons of ice per twenty-four hours, the condenser room, cold stores in the basement, together with workshops, stores, and the commercial and other offices for carrying on the business of the company.

The system of cold production, or rather heat elimination, employed by the Linde company is that introduced so successfully by Professor Linde, of Wiesbaden, some fifteen years ago, and is based on the evaporation of liquid anhydrous ammonia ($N H_3$). This liquid boils at atmospheric pressure at about 38 deg. below zero Fah., and is otherwise peculiarly fitted for use as a refrigerating agent, for it possesses a very high latent heat of vaporization, as well as a low specific heat and convenient condensing pressure. These properties combine to make it the most economical refrigerating agent known. The heat necessary for the evaporation of this liquid is abstracted from the surrounding bodies, which in practice are generally brine or air, and the ammonia vapor is then by means of compression, and contact with a surface condenser, again brought into the liquid form at a temperature depending upon that of the cooling water available. The liquid ammonia, thus recondensed, flows back into the refrigerator, and is then again evaporated, so that the same small quantity of ammonia is continually subjected to the same cycle of operations.

The apparatus necessary for an ice making plant on the Linde system consists mainly of three parts, viz., the compressor, the condenser, and the ice generator, with which is combined the refrigerator. The ammonia compressor is a double acting pump, the principal feature of which is the stuffing box, which is specially constructed to fulfill the important function of preventing the escape of the ammonia vapor. This, we believe, has been found to be a matter of difficulty in other machines, but it is most successfully attained in the Linde machine, by placing in the stuffing box two systems of packing, one behind the other, and leaving a chamber between them, which is filled with an oleaginous sealing liquid, standing under pressure.

This liquid absorbs any vapor that may pass the first packing; and if there should be a slight leakage of the liquid into the cylinder, it lubricates the piston and other internal parts, and is then carried away with the ammonia vapor. By this arrangement leakage of ammonia is practically entirely avoided, and the value of the chemical lost is inappreciably small. In order to prevent any of the sealing liquid entering the condenser or refrigerator coils, and so reducing their efficiency, a collecting vessel is inserted in the delivery pipe from the compressor. The liquid here collected is taken to small rectifying apparatus, in which the absorbed ammonia is separated from the oil, and conducted into the suction pipe, while the rectified oil is again used in the stuffing box. As already stated, the suction pipe of the compressor communicates with the refrigerator and the delivery pipe with the condenser. It is particularly worthy of remark that in the Linde system the compression of the vapor is accomplished nearly isothermally, the compressor not only requiring no artificial cooling by a water jacket, but being generally covered with frost when the machine is at work. The power expended in compression is in this way much reduced.

The ammonia condenser consists of a number of wrought iron tubes, each welded into one single length. These tubes are usually formed into helical coils, of varying sizes, placed one within the other in a cylindrical water tank. The compressed ammonia vapor enters these coils at the top, and is condensed by the cooling action of a circulation of cold water in the tank. The liquid ammonia is then led back to the refrigerator through a regulating valve.

The ice generator generally adopted by the Linde company consists of a wrought iron rectangular tank filled with brine and containing in its bottom part the refrigerating coils, the ice moulds being suspended in the brine above. The moulds are placed in suspended frames running on wheels along horizontal rails, and are so arranged that they can be simultaneously moved forward by gearing. The forward movement of the moulds is toward that end of the tank at which the fully frozen moulds are taken out, and thus a space is continually left at the opposite end of the tank in which to place moulds just filled with fresh water. When one row of moulds is frozen up, it is lifted from the tank by means of a traveling crane worked by power, and it is lowered into a vessel filled with warm water, called the thawing tank. In this the moulds are allowed to remain for a few seconds until the ice is detached from the sides; the moulds are then lifted out of the thawing tank, and tilted over by means of a tipping table, so as to allow the blocks of ice to slide out. The empty moulds are at once taken to the other end of the tank, when they are simultaneously filled with measured quantities of water, and replaced in the brine for a renewal of the freezing process. Only one workman is required for the whole of these operations, hand labor being entirely avoided. The ice made as above is more or less opaque, depending upon the nature of the water dealt with and the speed at which the ice has been frozen. In order to produce transparent ice, one of two courses must be adopted. Either the water must be agitated during the freezing process, so as to allow the air to escape, or the ice must be made from distilled water, from which the presence of air has been carefully excluded.

The plant at Shadwell consists of one machine capable of producing in regular work 100 tons of ice per twenty-four hours, and another independent machine capable of making 50 tons of ice in the same time, together with the ammonia condensing arrangements, ice making tanks and distillers, refrigerator for providing the supply of cold brine for the cold stores, and the boilers and steam engines for driving the compressors.

The boilers we have already referred to as presenting no special features. They are ordinary Lancashire boilers, of steel, made by Messrs Joseph Adamson, of Hyde, and are of such capacity that two boilers can supply steam for working the whole of the plant, leaving one boiler always in reserve. They are worked at a pressure of 100 lb. per square inch. In the boiler house are placed two distillers, which together are capable of producing about 30 tons of distilled water per day. The steam used in these distillers is obtained from the main boilers, and as the distilled water is cooled by means of water afterward used for feeding the boilers, it will be seen that the waste of heat is extremely small. Consequently the cost of ice produced from distilled water is but little in excess of that made for the ordinary town supply.

The steam engines and compressors, which are shown in perspective in our engraving, were made by Messrs. Sulzer Brothers, of Winterthur. The plant we illustrate consists of two sets of twin compressors, one having an ice making capacity of 100 tons per twenty-four hours and the other a capacity of 50 tons per twenty-four hours, so that if applied to ice making the production of ice per twenty-four hours would be no less than 150 tons. As a fact, however, the ice production is 130 tons per twenty-four hours, the remaining twenty tons capacity being at present used for refrigerating the cold stores. In each case each set of compressors is driven by a horizontal jet condensing single cylinder steam engine, with Sulzer valve gear, which, with steam of an initial pressure of 100 lb. per square inch, produces an indicated horse power with 17 lb. of steam per hour. These engines also drive the lifts, cranes, crushers, electric light, fans, etc. They are an extremely fine job, massive though not too heavy, and well finished off in every respect. The steam cut-off is directly controlled by the governor in the most economical manner, a point of great importance in a plant like this, where, owing to the number of different machines to be driven, the demand for power is constantly varying. The arrangement of compressors is clearly shown in the illustrations. Each set is driven from a single crank at the end of the engine crank shafts, one of the compressor rod ends being forked, so as to preserve the same center line for both. The suction pipes and pump covers are shown covered with frost, as they appear in actual work. Power is transmitted throughout the building by means of rope gear and shafting. The arrangement in the engine room is such that the 50 ton compressors, which are shown on the left, can be driven from the large engine, and this is the plan generally adopted when the full refrigerating effect is required, the one engine driving the four compressors and all accessories.

An important matter in an establishment such as this is the water supply. When the works were first designed, the intention was to obtain all water for cooling purposes, and, if possible, for ice making also, from a deep well to be sunk in the premises. This well actually was sunk at a cost of some thousands of pounds, but unfortunately it proved almost dry, though carried to a great depth. It became necessary, therefore, to make arrangements for taking the cooling and condensing water from the river, and this is the source made use of up to the present time, the water for ice making being taken in part from the distilleries already referred to and in part from the water company's mains. There are, however, considerable drawbacks to the use of river water, not the least of which is the large quantity of mud which is drawn in with the water, more particularly at low tide, and which is deposited in the various vessels and pipes. To avoid these drawbacks the Linde company are now erecting an apparatus for recooling the cooling water, according to a plan which has for some years been extensively adopted in connection with their installations in situations where water is scarce or dear. When this recooling apparatus is in full working order they will be independent of the river supply, as the same water will be used over and over again.

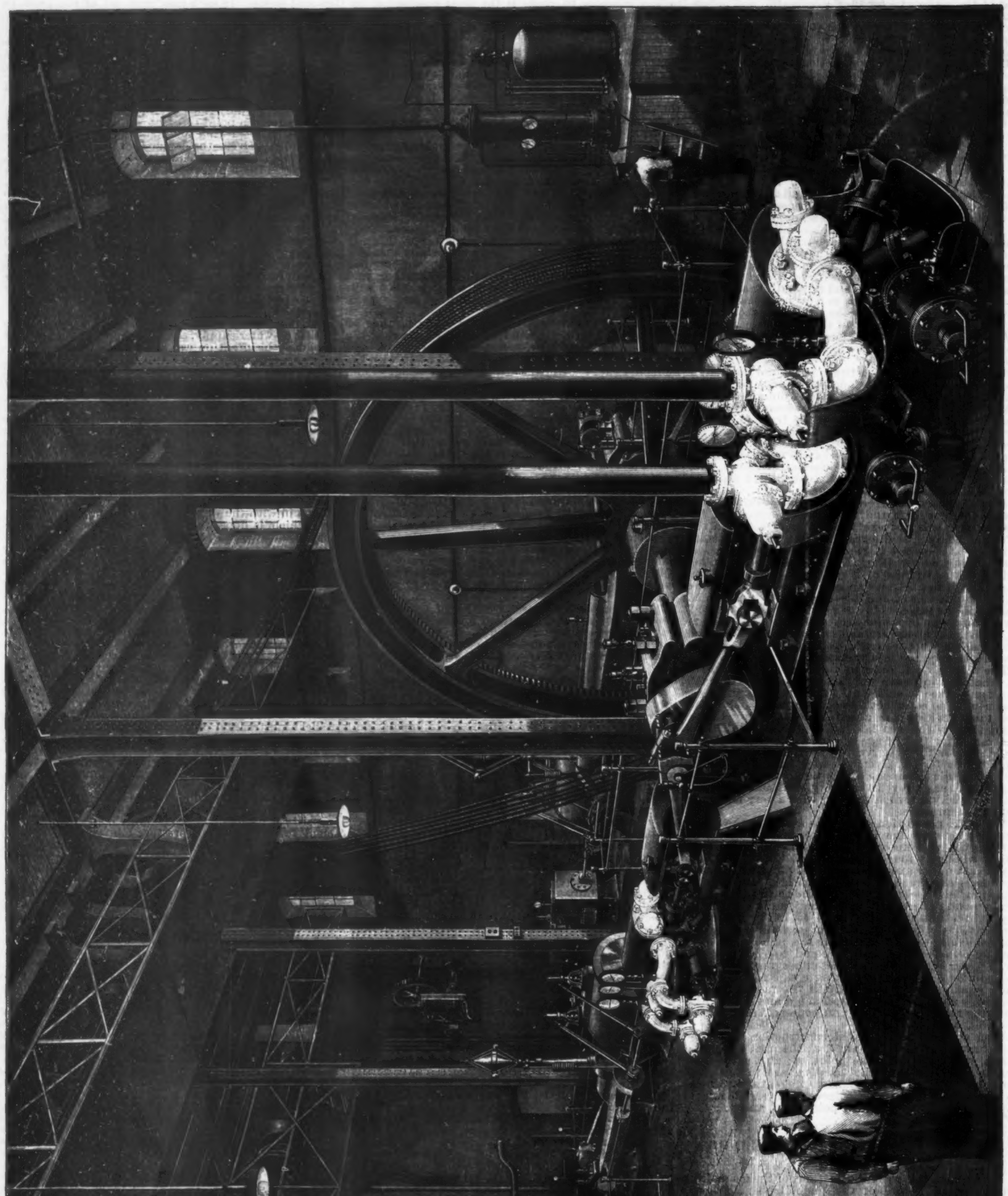
Recent tests were made by entirely independent engineers, who worked the machinery for some weeks, and designed all the testing appliances, and they show a very high state of efficiency attained by the Linde machine. With brine leaving the refrigerator at 23 deg. Fah., and cooling water at 68 deg. Fah., 231,144 thermal units were abstracted per hour, with an indicated horse power in the steam cylinder of 18·26, giving a heat abstraction of 12,650 units per indicated horse power per hour. It is claimed by the Linde company that this result is at least 20 per cent. better than the result obtained with any other refrigerating machine by independent trials. A very large number of tests were made with varying temperatures of brine and cooling water, all of which show equally good results.

The ammonia condensing plant herewith illustrated consists of six condensers, each having a capacity sufficient for a 25 ton compressor; one condenser being connected as a rule to each of the 25 ton compressors, and one to each of the 50 ton compressors. The construction of the condensers has already been explained, and we need only add here that each condenser tank is provided with an overflow weir for measuring the quantity of water passing; so that, with the aid of a thermometer, the duty of each condenser can be ascertained almost by inspection.

A perspective view of one of the ice making rooms is shown. There are two such rooms, one with apparatus for producing blocks about 3 ft. 3 in. long by 14 in. square, weighing about 2 cwt. each, and the other with apparatus for blocks of the same length but 14 in. by 7 in. in section, and weighing about 1 cwt. each. Any other size of block can be produced, but the foregoing are those which have been found to be most suitable for the requirements at Shadwell. The engraving shows the upper tank, in which the large blocks are made. These are produced from the East London Company's water, and are made in two qualities, opaque and crystal. The former is chiefly used for crushing, the company sometimes supplying as much as seventy-five tons of crushed ice in one day for the fishing boats. The crushers are placed immediately in front of the platform on which the ice is delivered from the moulds. The crushed ice falls into a creeper, and is discharged into a shoot which conducts it into the boats.

The crystal ice is made by agitating the water during the freezing process, so as to permit the air to escape. There are many different methods of agitation, but the system adopted in the present case is to use a long blade for each mould, to which a to-and-fro movement is imparted by means of overhead crossheads, to which the blades are connected. These crossheads are carried in grooved rockers, and in this way they are free to move forward in the direction of the grooves, so as to follow on with the moulds, but are fixed laterally. As the ice forms, the space available for the movement of the blades becomes reduced, and it is necessary therefore to gradually reduce the amount of oscillation. This is done automatically. Finally, the blades must be removed to allow the blocks to close up. In the lower room the ice is made from distilled water, from which all air has been carefully excluded, and perfectly clear crystal blocks are produced without any agitation at all. With this exception the arrangements are the same as in the upper room. Labor saving appliances have been adopted wherever possible. One man controls all the operations connected with filling the ice moulds, agitation, moving the moulds forward, and thawing off and discharging the ice. For crushing and delivery into barges the only labor consists in moving the blocks forward a few feet to bring them over the crushing rolls, while for delivery to the street self-acting lowering hoists and endless chains are employed.

The cold stores, having a capacity of about 60,000



VIEW OF ENGINE AND COMPRESSOR ROOM OF 150 TONS ICE-MAKING PLANT.

THE LINDE BRITISH REFRIGERATION COMPANY'S WORKS, SHADWELL.

AMMONIA CONDENSERS.

ICE-MAKING TANKS.

cubic feet, are situated in the basement. They are insulated in the usual way, and are maintained at the desired temperature by means of overhead pipes, through which cold brine is circulated, as well as by means of a current of air, which is cooled to any desired temperature in a special apparatus, and circulated through the rooms by a fan. This latter is the system now recommended by the Linde company, as it not only dispenses with all brine or other pipes in the storage rooms, but, by creating thorough ventilation, keeps the meat in better condition; and in all modern installations, except where brine pipes are specially desired, some system of air cooling, external to the storage rooms, is adopted. Thus, for instance, the powerful chilling plant now being erected by the Linde British Refrigeration Company at the Woodside Lairage of the Mersey Dock and Harbor Board has such an arrangement, the air being cooled, and then conducted by suitable trunks into any or all of the six chill rooms. In this way chilling can be effected much more rapidly than is possible with the overhead brine pipes, where the circulation of air is very sluggish, and all trouble of drip from the pipes and other inconveniences is avoided.

On board ship also, brine pipes are entirely dispensed with. The great advantage of this can be at once recognized when it is considered that, apart from the question of drip from the condensation of moisture on the exterior of the pipes, the effect of a leaky joint or burst pipe might produce most serious consequences before the defect was discovered and repaired. At the present time the Linde British Refrigeration Company has in hand no less than seventeen ships' machines, some of them of very large size. Four vessels are being fitted up, each for carrying 750 tons of frozen meat; while Messrs. Harland & Wolff, of Belfast, and Messrs. J. & A. Allen, of Glasgow, are fitting vessels for the carriage of large quantities of chilled beef. On the other hand, smaller installations are being fitted on board passenger vessels for preserving provisions, for making ice, and for cooling wine, water, etc., merely for passengers' use. Altogether up to the present time over 1,100 machines on the Linde system have been supplied, many by the Linde British Refrigeration Company, Queen Victoria Street, of which Mr. T. B. Lightfoot, C.E., is the managing director.

DIRECT ACTING HYDRAULIC PUMPING ENGINE.

WE illustrate below a type of direct acting pump which is designed to be driven by water pressure having "heads" from 300 ft. to 500 ft., or even 1,000 ft. The pump has been designed and constructed by Messrs. Knight & Co., engineers, Sutter Creek, Amador County, California, and the credit of its gradual evolution is mostly due to Mr. Samuel Knight, who has devoted many years to the application of high pressure water power to mining operations.

The main cylinder is 12 in. diameter, and is of wrought iron, and the side pipes are steel castings. The principal feature, and the one that finally led to noiseless and successful working, is the use of independent exhaust valves. The induction valves are moved by the auxiliary cylinder shown on the top. The working of the machines is quite noiseless, and there is not the least jar even when 500 ft. of heavy pump rod are connected with the engine.

Four of these large pumping engines are now work-

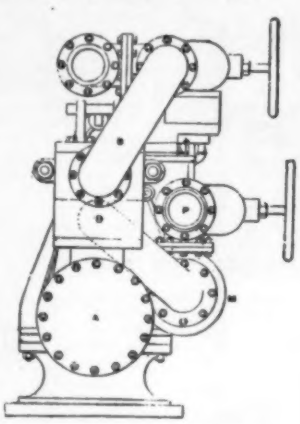


FIG. 4.—BACK END VIEW.

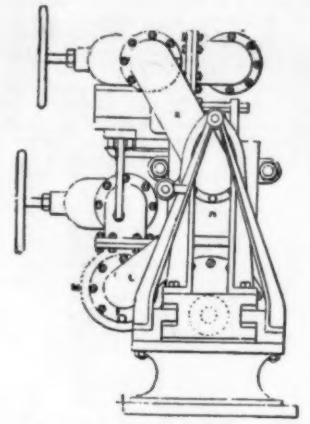


FIG. 5.—FRONT END VIEW.

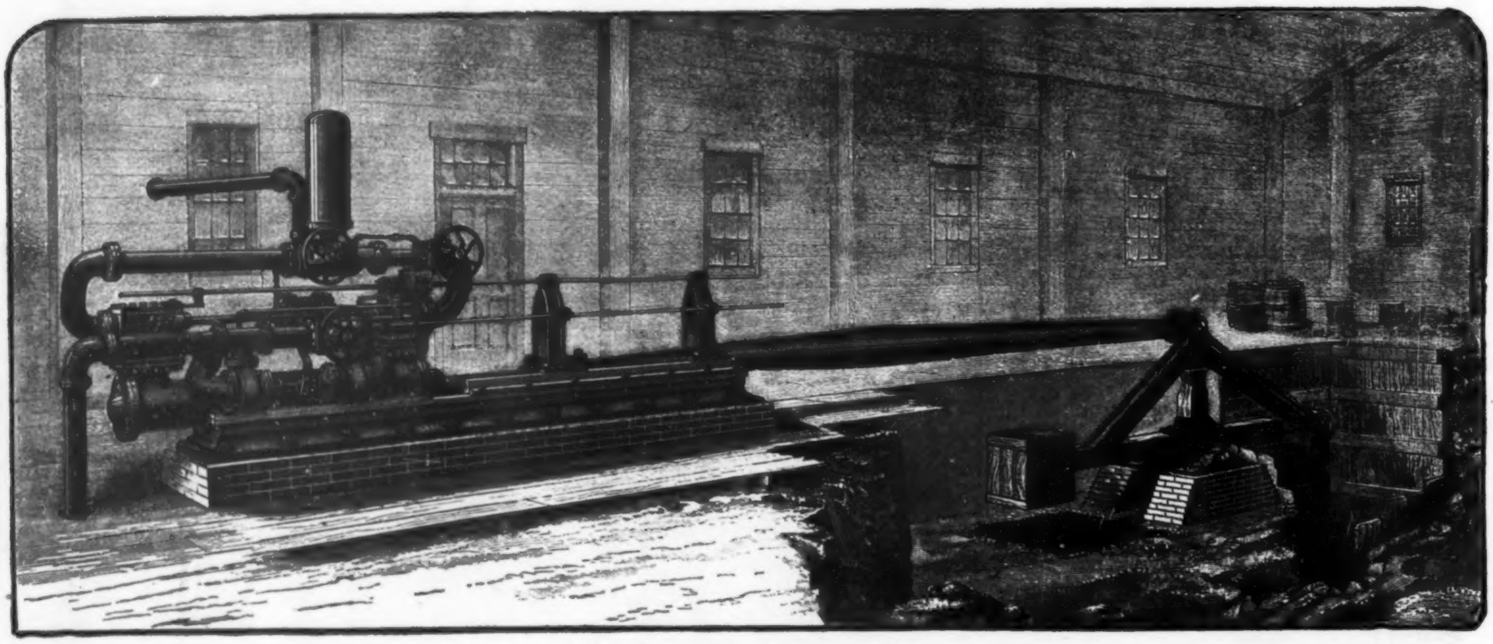


FIG. 1.—GENERAL VIEW OF PUMPING PLANT.

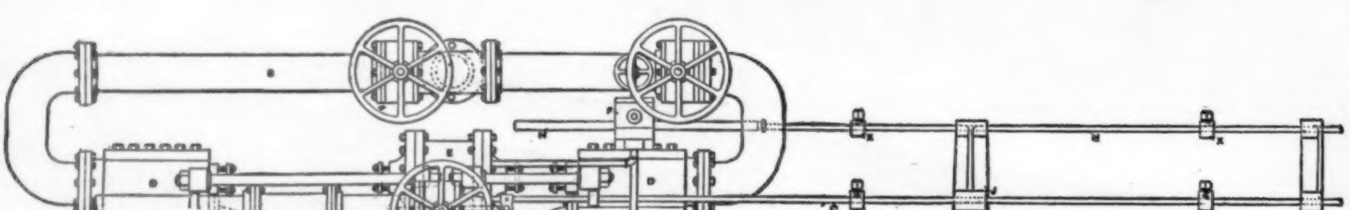


FIG. 2.—SIDE ELEVATION OF PUMP.

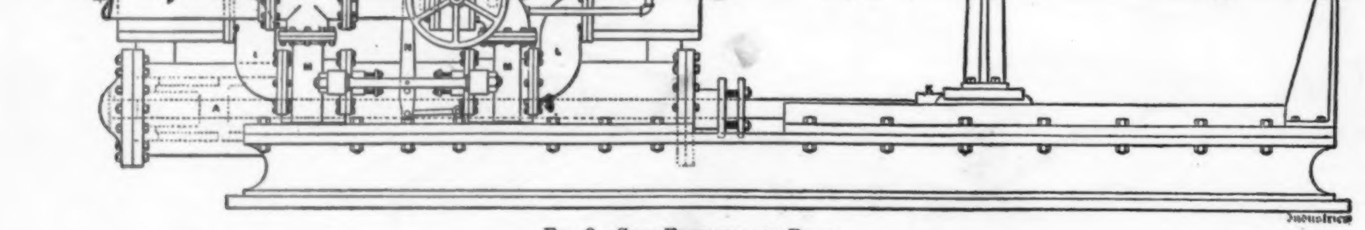
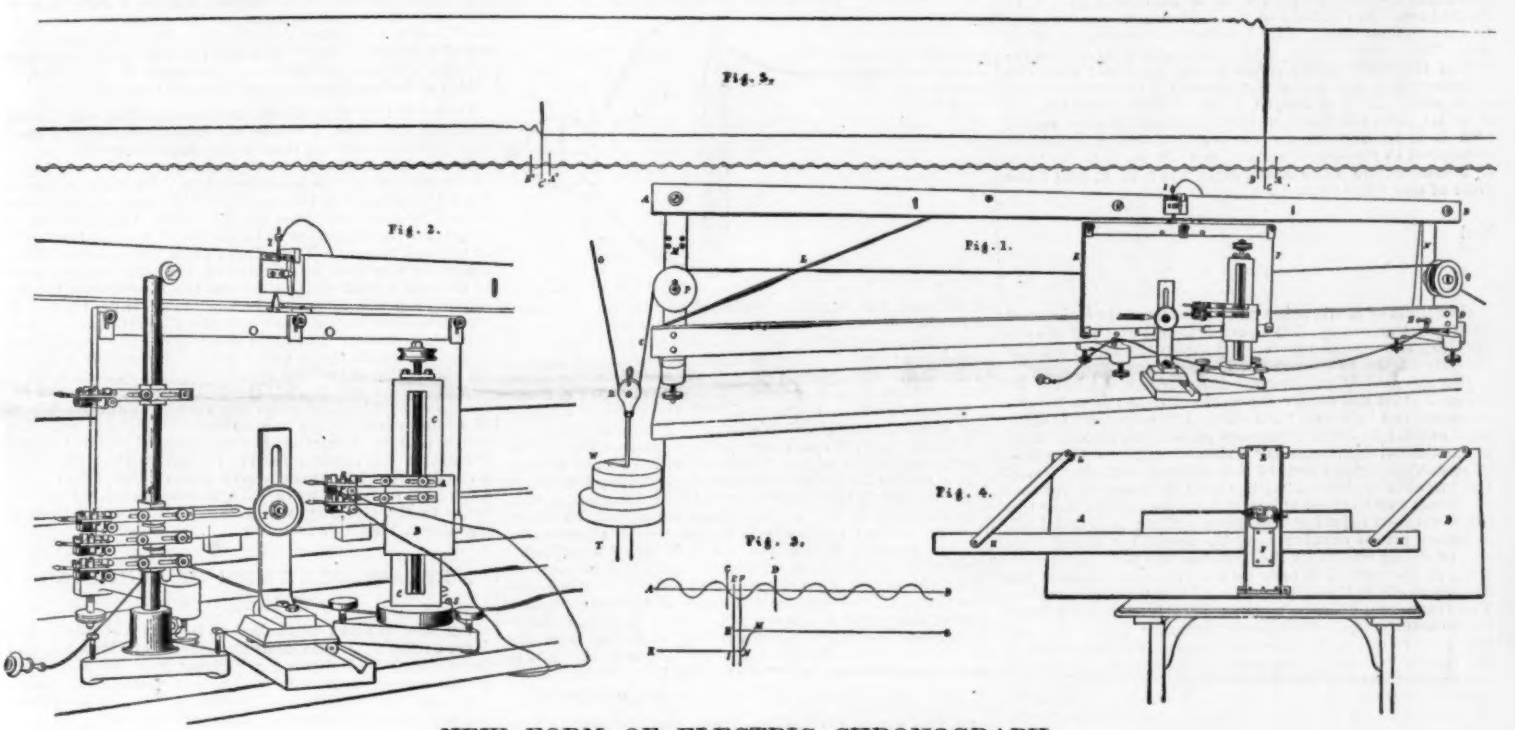


FIG. 3.—PLAN OF PUMP.

IMPROVED DIRECT ACTING PUMPING ENGINE.

ing with driving "heads" as follows: One with 336 ft., two with 460 ft., and one with 720 ft. The efficiency of the engines has been carefully tested, and is found to be 75 per cent. The firm guarantee this efficiency for all engines when the diameter of the main cylinders is 12 in. or more.

The illustrations show the details of one of these pumping engines constructed for the Plumas Eureka mine, in California, to operate under a head of 720 ft.—*i. e.*, with a pressure of 310 lb. per inch. A is the main cylinder, B B induction pipes, the water entering at C. In the two boxes D D are two plain side valves actuated by the auxiliary hydraulic cylinder E. This cylinder E is controlled by a small slide valve in the box F, which is operated by the sliding tappet G and the rod H. The stop collars I on H are moved by the bracket J, which is mounted on the crosshead at K. The tappet G, shown in the plan, is one of the "pass through" type, and acts some time in advance of the main valves. The exhaust pipes L L extend from the valve boxes D D down to two balanced cylindrical valves at M, which control the exhaust flow as it passes to the waste pipe P. This is the main point in Mr. Knight's invention, and the secret of smooth working in his machines. These two piston valves at M are operated by a lever N and a second tappet rod O, which imparts a slow movement to the valves. The valves thus begin to close and choke the exhaust soon after the piston has reached its maximum velocity, and gradually bring the water and also the heavy pump rods, to a state of rest at the end of the stroke, just as a crank would do. As the tappets on the rod H outrun the main valves at D D by a foot or more of piston movement, it leaves the range of stroke to be controlled by the rod O and the retarding valves at M, so that by shifting the collars on the rod O the reciprocating parts can be cushioned and brought to a state of rest, avoiding all shock and danger to the pipes or machinery. We may explain that the pipes for conveying water in the mining districts of California are mostly of thin sheet iron, and so connected that the



NEW FORM OF ELECTRIC CHRONOGRAPH.

least shock is liable to rupture them. In this matter Mr. Knight has found his greatest difficulty, and, besides arranging his engines in the manner explained for easy cushioning, has to place air vessels on the pipe lines to avoid shock.—*Industries.*

A NEW FORM OF ELECTRIC CHRONOGRAPH.

By Rev. FREDERICK J. SMITH, M.A., Millard Lecturer in Mechanics and Physics, Trinity College, Oxford.*

DURING the last two years a research has been carried on by me on the subject of the acceleration period of explosions.† In order to deal with the time measurements which arose out of the investigation, it was found necessary to devise a chronograph which would register a large number of events following each other after small periods of time. As the chronograph used in these experiments has been found to be of use in other branches of scientific work, viz., in determining the velocity of shot, and many physiological time measurements, I beg to offer an account of its construction and use to the readers of the *Philosophical Magazine*. The instrument has been called the electric tram chronograph, because the moving surface is carried upon wheels running on rails.

The instrument has, in common with other forms of time measuring instruments, a moving plate on which traces are made by means of electromagnetic styli. In other respects it greatly differs from other forms of time measuring instruments.

In order that an electric chronograph may be of general use, several conditions have to be complied with; some of these are as follows:

1. The moving surface on which the time traces are made should be both long and wide. It should be *long*, so that periods greatly differing in their duration may be recorded on the same surface close together. It should be *wide*, so that a large number of time determinations may be made and compared side by side on the same plate.

2. The experimentalist should be able to vary the velocities of the moving surface.

3. The surface should so move that all the time traces may be in straight lines, and the velocity of the surface should be uniform during an experiment. The necessity for uniform movement is forced upon one by the experience of the difficulty found in subdividing a tuning fork trace as recorded by a pendulum chronograph. When a time record is made on a surface which is moving at a uniform velocity, the difficulty of accurately subdividing a single vibration at once disappears.

4. The marking points of the electromagnetic styli, actuated by springs, when released from an electromagnet, should make a sharp and definite mark; also the time between the breaking of the circuit and the marking should be as short as possible, and it should be constant in value.

These ends have been attained in the following manner: To a vertical carriage running on wheels, between two rails, a sheet of smoked glass is fixed. The carriage is impelled by means of a cord attached to a weight; after the weight has acted upon the carriage through a certain length of fall it is arrested, and the carriage moves with the velocity it has attained. This velocity is found to be practically constant for the whole length of the trace. It will be noticed that this arrangement embodies the principle of the Atwood machine. It will also be noticed that the impulse given by means of the falling weight gives a maximum velocity at the point where its pressure is taken off. With respect to pressure given by a spiral spring, as used in the well known shooter employed in physiological work, exactly the opposite of this takes place. The writing points of the electromagnetic styli and the tracing point of the tuning fork are placed so as to mark the moving surface.

The distance between the markings of the styli is obtained in terms of the length of the vibrations of the fork; from this the time between two or more markings is determined. This will become clear from the consideration of the following detailed description of the instrument.

The rails.—Two steel rails, A B and C D, each two meters long (Fig. 1), are attached to three cast iron standards; two of these, M and N, are shown. Each standard is furnished with two leveling screws. The upper rail is adjustable, so that it may be placed parallel to the bottom rail, and at a correct distance from it for the width between the wheels of the carriage. (The rails are slightly inclined from D to C.)

The carriage, E F, is built up of bars (which are not shown), so as to be both light and rigid. It runs upon three wheels, each wheel being carried on two steel points; the points are adjustable, so that the face of the carriage can be placed parallel to the plane of the rails. To the front of the carriage a sheet of smoked glass is fixed with clips and screws. The carriage is furnished with a catch which engages with a detent at H; by this it is held back against the pull due to the weight, W, until required to run past the styli. A projection at the back of the carriage engages with a leather brake band.

The brake.—A band of leather, L, is fixed to the standard, M, and also to a strong spiral spring at the back of the upper rail; the projection previously mentioned rubs under the band and brings the carriage to rest without any concussion.

The weight.—A gut band or cord, passing over the pulleys, Q, P, R, is fixed at G; it is provided with a small ball which engages with a fork fixed to the back of the carriage. The weight impels the carriage until it is arrested by contact with an adjustable table, T; the carriage then runs on with the velocity acquired. The velocity is found to be practically uniform throughout the whole length of the time trace. The cord, if free, has a velocity approximately double that of the driving weight.

Electromagnetic styli.—These are shown at A A, Fig. 2. An electromagnet of peculiar construction is mounted upon a brass plate which carries a T-shaped lever; to this a writing point of aluminum, mica, or parchment paper is attached. The lever is held by the electromagnet, as long as a current is acting upon it, against the pressure of a spring; when the current is broken the lever rises and gives its marking. The electromagnet is so constructed and wound that its period of "latency" is exceedingly small, and also constant within close limits. By means of a flat rectangular spring the stylus is attached to a pillar furnished with a sliding holder, B; each stylus can be easily adjusted to a vertical line for experiments in which a large number of markings are required in succession.

The pillar support.—It has been found that, unless the support of the styli is free from vibration, the trace produced by them is not worth much. The pillar used in connection with the instrument consists of a heavy iron casting, C C, Fig. 2, fitted with a slide, B. The slide can be raised or lowered by means of a screw with a milled head. The styli are attached to the slide B. By raising the slide after each experiment a large number of traces can be made side by side, and by the addition of an extra carrier as many as ten styli can be carried. The pillar can be rotated on a triangular base, which is supported upon three leveling screws. The screws rest after the method of Sir W. Thomson, viz., in a hole, a groove, and on a plane, on the slab which supports the chronograph. The points of the styli are adjusted to the face of the glass by a screw, S. A simple pillar, A', can also be used when only one set of traces is required.

The tuning fork.—A tuning fork, T, is carried upon a pillar which slides upon a block in which a V-groove is cut; a screw stop limits its position against the glass. The fork may be driven electrically or it may be excited otherwise. In the experiments on explosions the fork was started by means of a wedge, which kept the prongs apart, being suddenly withdrawn by means of an electromagnet.

The latency of electromagnetic styli.—While going through a large number of papers upon investigations in which electromagnets were used for measuring time, it was found that in nearly all cases it had been assumed that the armature of an electromagnet was detached at the instant of the circuit being broken; also, that in two instruments of similar construction the armature was released at the same instant. Several electromagnets of chronographs were examined; in some cases, where much iron was used in the cores, the time between breaking and release of the armature was as much as 0·04 second; also two apparently similar shaped electromagnets with similar windings, equal currents being used, differed in their action by some hundredths of a second. The experiments showed in a very definite manner that some electromagnets were not to be depended upon for close and accurate work.

In order to produce an electromagnet stylus free from these evils, a large number of experiments were gone through on the relative proportions of the cores and their yoke, also upon the winding. It was found that the yoke should be made large as compared with the cores; the dimensions finally adopted were:

Cores........	2 millim. diam.; 10 millim. long.
Yoke........	20 millim. × 5 millim. × 5 millim.

The method of measuring the period of delay spoken of, which may be called the latency of the stylus, is as follows. It may be taken as an example of the way in which the instrument is used (see Fig. 3): A piece of warm glass is smoked over the flame of a paraffin lamp furnished with a wide wick; it is then attached to the carriage, and the stylus to be tested is adjusted to the surface of the glass, also the tuning fork is adjusted so that its writing point lightly touches the glass; an electric circuit is then completed through the break, I (Fig. 2), and the stylus prepared for giving the signal. The carriage is then brought slowly past the stylus, the result of which is that a vertical mark, I H (Fig. 3), is produced; the carriage is then held back by the detent, the stylus is again prepared, by the armature being caused to touch the poles of the electromagnet, the fork is excited, and the carriage released; the markings, K N M L and A B, are then produced. The tuning fork point is brought against the glass so that a straight line may be drawn by it. The intersections of this with the curved line determine the limits of any

* Communicated by the author.

† Proceedings of the Royal Society, xlv., p. 451.

vibration. The length of the traverse, I N, duly turned into time, is the latency of the stylus. Lines are drawn by a needle's point through the points, I and N, cutting A B in E F; the value of E F is then determined by means of a micrometer microscope, constructed as shown in Fig. 4. In all cases of estimating time the fork is excited for each observation, the writing point of the fork being placed vertically above the writing points of the styli, so that the velocity of the moving surface is common to both the fork and the stylus. The needle point for scribing the vertical lines is carried on a kind of dividing engine. The styli are found to have a latency of almost perfect constancy, its value being 0·0003 second. The first stylus constructed by me, and used in the Physiological Laboratory of the University, was not proportioned as the later ones have been; it was tested by Prof. G. F. Yeo, and his result, published in the *Journal of Physiology*, vol. ix, Nos. 5 and 6, gave as a value of latency 0·00062 sec. The improved result, viz., 0·0003, has been arrived at by a careful selection of the iron used, and a modification of the winding of the bobbins; by the reduction of the latency the marking is rendered much more definite and readable. Two fac-simile tracings (Fig. 5) show the nature of the markings of a time trace of a slow explosive wave. $\dot{B}\dot{A}$ or BA equals 0·00237".

The micrometer microscope is mounted on a bridge, E F (Fig. 4), attached to an inclined table, A B; it is carried by means of a slide, which permits movement parallel to the trace which is put under it; the slide is moved by a screw having 40 threads to the inch; the screw has a micrometer head divided into 25 large divisions, each of these is again divided into 4 parts, so that $\frac{1}{40} \times \frac{1}{100} = \frac{1}{4000}$ of an inch can be read with ease. The microscope is furnished with a fine fiber which is brought over the trace to be measured; a rod of rectangular section, H K, is attached to two links or rods, L H, M K; the links being equal and moving about the points, M, cause the rod to move always parallel to itself; upon the rod the trace rests; any part of the trace can be brought under the microscope. The markings appear as rather wide lines of light; a V-shaped scale in the field of the instrument enables one to bisect these lines. Fig. 3 gives an illustration of its use. The center of the field is brought over C, the index of the micrometer screw being at zero; then the microscope is moved by the screw till the center coincides with D. The length, C D, is then recorded, let it be L; then the micrometer is brought to zero again, and E is brought under the center, and E F is then measured in the same manner as C D, let it be l; then, if x denote the time of traverse over E F, and t the time of one vibration,

$$L : l :: t : x$$

and

$$x = \frac{lt}{L}$$

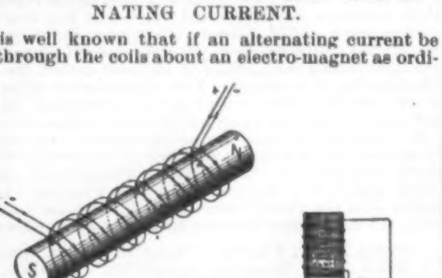
Fractions of a vibration can thus be easily estimated with great accuracy. This proportional method of subdividing the vibrations depends upon the fact that the velocity of the carriage is practically uniform.

The method of preserving time traces.—After the smoked glass has received records of time traces it may be preserved by being varnished. It is a somewhat difficult matter to cover a smoked plate with photographic varnish without making either streaks on the plate or removing a good deal of the carbon surface; but if the varnish be diluted with about 25 times its volume of strong methylated spirit, it may be poured over the plate without injuring the trace. When it is dried off, ordinary photo varnish may be applied without any risk of doing harm. In the first case the plate should be cold, in the second it may be a little heated before the fire previous to the application of the thicker varnish. The traces can then be used as negatives to print from in the usual way. Eastman's bromide paper in rolls has been found to be most convenient for reproducing the traces. One of these is shown at Fig. 5. The lines are thicker than those usually made, as a thicker deposit of carbon was used to get a very dense negative to make a print for this communication to the *Philosophical Magazine*.

I wish to add that Mr. A. W. Price has greatly assisted me in the manufacture of the new instrument. The method of increasing the velocity of the carriage by the introduction of a pulley attached to the driving weight is due to him.—*Philosophical Magazine.*

MAGNETIZING IRON WITH THE ALTERNATING CURRENT.

IT is well known that if an alternating current be sent through the coils about an electro-magnet as ordi-



MAGNETIZING IRON WITH THE ALTERNATING CURRENT.

narily constructed, the magnetism of the core will be constantly reversed and no perceptible polarity will result. In order to overcome this effect and produce an electro-magnet by means of the alternating current, Lieut. F. J. Patten, of New York, has worked up the method which is illustrated in the cut. The constant current effect is brought about by winding the electro-magnet and connecting it to the source of current as indicated. Referring to the diagram, G is an alternating current generator, provided with a contact ring, B, and two commutator rings, A and C. These latter are divided into a series of segments, while the ring, B, is plain or undivided.

The main leads, A', B', C', have the termini of the magnetizing helices connected to them. On the middle or central lead, B', flows a true alternating current; but the main, A', conveys all the + currents out, say from the alternating current generator, and they return along the lead, B', and are indicated by single arrows pointing along the helix + +, from circuit A' to B'. The negative currents, indicated by double arrows and flowing, of course, in the reverse direction as concerns the leads, come out from the generator on the lead, B', and, passing through the helix designated — —, return on C'. But, as shown by the single and double arrows, both these currents are caused to circulate around the bar, N S, in the same direction. As these impulses, therefore, follow each other in succession without break or interruption, they maintain an unchanged polarity of the helices and inclosed iron bar, N S.

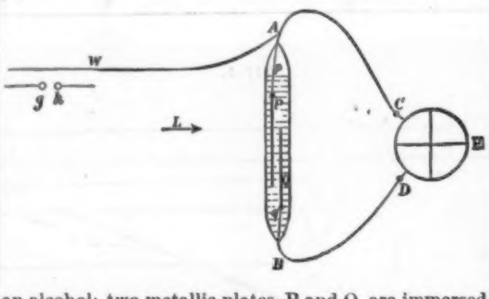
[NATURE.]

PHOTO-ELECTRIC IMPULSION CELLS.

BEFORE publishing in detail the results of many experiments on the generation of electricity by the action of light falling on certain sensitive substances, I wish to make known a result which seems to be of a most remarkable character.

In this communication I shall give merely enough information to enable a reader to understand the special result which I desire now to make known.

The photo-electric cell which I employ consists of a small glass tube, represented in the figure, filled with



an alcohol; two metallic plates, P and Q, are immersed in the liquid; each plate is connected with a platinum wire which may either be *soldered to the plate* or passed through a small hole in the plate and *pinched tightly to it;* these wires pass through the ends of the glass tube and are sealed into it. The poles of the cell are A B, and these are connected with the poles of a quadrant electrometer (Clifton's form of Thomson's).

The plate, P, is sensitized by a peculiar process, the mere publication of the details of which would not enable a reader to make it successfully. The publication of the process is therefore reserved for a future occasion. The plate, Q, is quite clean—not sensitized to light. The cell is fixed vertically in a clamp (not represented in the figure). When the cell is of the "impulsion" kind, what happens is as follows. Daylight (represented by the arrow, L) being allowed to fall on the sensitive plate, P, the spot on the scale of the electrometer moves, and after a few seconds comes to rest, indicating an electromotive force varying with the intensity of the light, its amount for such diffused daylight as we have at present (May 10) at noon being between ½ a volt and ¾ of a volt—which is, I submit, a surprisingly great magnitude.

On the withdrawal of the light, the deflection falls, and there are means of rapidly getting rid of the deflection without injury to the cell. Either before or after this deflection caused by light ceases, let a slight tap (sometimes inaudible) be given to the base or clamp in which the cell rests, and then results a remarkable change in the cell. *It is no longer sensitive to light.* This insensitive state is indicated by a rapid return motion of the spot on the scale; it is merely *indicated* by this motion, there being no necessary connection between this motion and the insensitive state, for if the cell were now left for some time (perhaps an hour or so) in the dark, the disturbing E. M. F. of the cell would vanish, and there would be nothing to tell us that the cell remains insensitive; but that it is really still in the insensitive state we find at once on again exposing it to light. Another gentle tap given to the clamp, or the stone table on which the whole apparatus rests, will restore the sensitive state; and so on indefinitely, the sensitive and insensitive states following each other and being produced, in the case of many such cells, with great ease.

These results I found a long time ago, and they have been seen by or communicated to several scientific friends. From the first, I maintained that the results are due to an alteration of the molecular state of the sensitive surface, or of the layer of contact of this surface with the liquid, and that in one arrangement of the molecules the light energy can be taken up electrically, while it cannot be so taken up in the other. In my first experiments the plates were tightly pinched to the platinum wires—not soldered, as soldering endangered the sensitive layer—and the obvious objection was made that "loose contacts" were unsatisfactory.

I have several results, however, which dispose of this objection, even in the case of very loose contacts; but I may set the matter at rest by saying that I have been able to make soldered junctions, and with them to obtain the results.

I now come to the special point which is the occasion of this communication. A few days ago I was investigating the effect of static charges communicated to the plates on the sensitive and insensitive states, and in the course of these experiments I found that if a Voss machine, not in any way connected with the cell or the electrometer, was worked in the room while the cell was in the insensitive state, *the moment a spark passed between the poles of the Voss, the insensitive state was altered to the sensitive,* whether the cell was connected with the electrometer or not.

Finally, I found that the best method of showing the inductive effect of the spark is to connect an insulated wire, W, apparently of any length, to either pole (A in the figure) of the cell, and to place the poles, g, h, of the Voss near the wire (a distance of several feet will do with a spark about half an inch long). If g and h are two or three feet from any part of the wire, W, a spark about one-eighth of an inch long suffices to change the cell from the insensitive to the sensitive state.

The effect is not one on the electrometer, nor is it due to sound, and I have repeated the results with several cells many scores of times before people interested in them. At present I am endeavoring to produce by *electro-magnetic induction* the reverse change, viz., that from the sensitive to the insensitive state; but, although such must apparently be possible, I have not yet succeeded.

The sudden alteration of the insensitive to the sensitive state is produced in a most marked manner by the spark of a Hertz oscillator at as great a distance as the laboratory room in which I work allows. This distance is usually only about eight or ten feet, but I observed the change effected occasionally when the oscillator was at the distance of some thirty feet or more. In this latter case, however, the action was interfered with by the unavoidable presence of wires along the walls, etc., intervening between the Hertz and my impulsion cell. If the cause to which I have assigned the change from the photo-electrically insensitive to the photo-electrically sensitive state of the cell is the true one, it is impossible to avoid the speculation that impulsion results of this kind may be very common in the economy of nature; and that the mode in which solar energy is taken up by plants may be affected, and even altered in kind, by sudden electro-magnetic disturbances. The effect of a Hertz oscillation is, indeed, not confined to an alteration of a plate from the insensitive to the sensitive state; for I have cells in which, if the sensitive plate is, on exposure to light, electrically negative to the back plate, a Hertz oscillator at a distance will reverse the relation when the plate is again exposed to light. GEORGE M. MINCHIN.

Royal Indian Engineering College, Cooper's Hill.

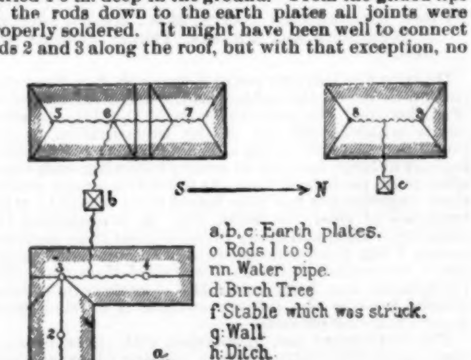
P. S.—While the above communication was going through the press, I made an experiment which renders it almost certain that in the impulsion cells the results are due to the formation of some *oscillating layer* at the surface of the sensitive plate. Being anxious to keep the alcohol in the cell (which in this instance was closed by a ground glass cap), I sealed the cell into a glass tube through the extremities of which the wires of the cell passed. The effect of the disturbance thus resulting was that no amount of tapping the support of the cell would change it from the sensitive to the insensitive state, although before being thus treated it was sensitive to the most minute disturbance. I suspected, however, that after some hours the liquid and the plate would again enter into the peculiar relation on which the impulsion results depend, and so it turned out—after three hours the cell could be rendered insensitive by taps and sensitive by the inductive effect of a Voss machine. The platinum wires were *soldered* to the plates. I see that the distances at which I found the Hertz oscillator effective in influencing the cells were greater than those above stated; but I have not been able to renew work with the oscillator, which belongs to Mr. Gregory, who removed it for exhibition at the Royal Society's meeting.

A REMARKABLE FLASH OF LIGHTNING.*

By W. KOHLRAUSCH.

ON May 15 last I was asked to inspect a stable on the farm of Mr. C. Jagau, near Hanover. On May 8 it had been struck by lightning, which set it on fire and killed a horse which was in it, and this, although the building had four conductors, in the immediate neighborhood of one of which the lightning struck.

The accompanying illustration shows the positions of the buildings and the conductors. To the east lies the yard, which seems to be quite unoccupied. To the south also there are no buildings within the distance of 100 m. It was at the request of Mr. Rudolph Siemsen, who had erected the conductors, that I went to see the place. The iron rods are 4 m. high and the 12-strand copper conductors have a cross section of 0·06 in. The earthplates are 100 by 50 cm.; those at a and b hang right under water in two wells; that at c is buried 1·5 m. deep in the ground. From the gilded tips of the rods down to the earth plates all joints were properly soldered. It might have been well to connect rods 2 and 3 along the roof, but with that exception, no



fault could be found with the arrangements. Those in the house had no idea that the stable had been struck until, shortly after, they saw smoke coming from the roof, and found that some loose hay lying in the loft was burning, which was easily extinguished; but it was found that a horse was lying dead just with-

* From the *Elektrotechnische Zeitschrift*.

in the door. Distinct traces of the flash, in the form of numerous small splinterings, could be seen on the first two beams going to the northwest, under the ceiling of the stable behind the door *e*. Wood was splintered both on the inner and outer sides of the door itself, and here and there its nails and bars were melted at the ends and angles. The yard gate was also splintered. Finally, on the birch tree *d*, at about 1·7 m. from the ground, we found two burns, which were undoubtedly fresh, and which had gone through the bark to the better conducting interior of the tree. The most careful search has not brought to light any other traces of the lightning's course. We took down the conductor 1, but even with a magnifying glass could find no traces of its being touched by lightning. Rod 2 we examined through a telescope with the same result. The common conductor of rods 1 and 2 goes to earth at the well *a*. The water was about 1·5 m. below the ground. The well is built in sandstone, and is about 3·5 m. deep. The earth plate *a* was quite under water.

Earths *a*, *b*, *c* were 10 ohms, 11 ohms, and 32 ohms respectively. There is thus nothing much against the arrangement of the conductors. It would have been better had the resistances of the earths been smaller, and had rods 2 and 3 been connected; but I think one can hardly say that the buildings were insufficiently protected, and I can find no definite reason for the fact that the lightning injured them; and, moreover, injured them at a spot certainly not beyond the commonly supposed protective distance of the rod, and which was nowhere more than 5 m. from either end of the rod. In this region the ironstone, which lies generally about a meter below the surface, in various sized beds, has a great deal to do with determining the course of a flash of lightning; but on digging in the stable, near the birch, and round the neighborhood where the lightning struck, we came to the water level at 1·25 m. down, but found no ironstone. The nearest we found was a small bed in the field, toward the east and about 25 m. from the stable. The field lies about 0·8 m., and the water in the ditch *h* about 1·3 m. lower than the yard. In the stable or beneath it was no amount of metal worth mentioning. No farm implements were kept there; the stable was empty, save for the horse, which happened to have been put there temporarily.

The following explanation is possible: The lightning struck the highest point in the neighborhood, the birch *d*, passed through the twigs at *n*, which touched the roof of the building, and also through the tree, coming out lower down the tree, from whence it injured the yard gate *m*. All visible traces left by the flash fit in with this theory, for all the injuries to the building itself are just under the twigs *n*.—*Electrician.*

SINKING OF THE QUETTA.

THE Quetta was a screw steamer of 2,254 tons net, was built in 1881 on the Clyde, and was owned by the British India Associated Steamers (Limited). Since the establishment of the Queensland line, the passage on which the Quetta was engaged had been made without accident of any kind by 197 vessels. Great astonishment, as well as consternation, was therefore felt when a telegram was sent from Lloyd's agent at Brisbane, dated on the evening of March 1, announcing that the Quetta had struck on a rock near Somerset, Torres Straits, and sunk within three minutes, carrying with her a large number of her crew and passengers. There were on board 282 souls, including some 60 Javanese, and of these 149 were saved and 133 were lost. The Quetta sank broadside on, some plates having been torn out by the collision with the rock. The boats which left the sinking ship were all subsequently accounted for.

It was at first reported that the colored crew had behaved badly, thrusting the ladies aside, and making a rush for the boats as soon as the vessel began to go down. This statement is correct as regards the Javanese deck passengers, but unfounded as regards the Lascars, who formed part of the Quetta's crew, and who behaved admirably. The excessive number of fatalities among the ladies on board is attributed to the fact that at the time of the disaster they were sitting under an awning, which carried them down with the sinking vessel. The rock on which the Quetta struck does not appear to have been marked on the charts. Our engraving is from a sketch by Mr. John Comyns, Hawthorne, near Melbourne, Victoria.—*London Graphic.*

THE LOSS OF THE S.S. QUETTA OFF THURSDAY ISLAND, NORTHERN AUSTRALIA.

The Quetta struck on an unknown rock near Somerset, Torres Straits, and sank in three minutes with the loss of 133 out of 282 persons on board. The survivors were rescued from a neighboring island by the Merrie England and the Albatross.

OLEOMARGARINE.*

By Prof. JAMES F. BABCOCK.

THE truth of the saying that "History repeats itself" is shown in the unreasoning hostility which oleomargarine has always encountered from certain interests. It has happened many times in history that the selfishness and ignorance of a particular class have induced them, regardless of the general welfare, to delay or obstruct the progress of what, in the end, has turned out to be a beneficent and useful invention.

We have not far to look for illustrations. In 1834, a convention of farmers and stable keepers was held at Albany to protest against the further development of railroads. They declared, as the opponents of Stephenson had done, that if railroads were allowed to obtain a foothold, turnpike roads would be deserted and grown up with grass; country inns would be ruined, the race of hostlers and coach drivers would be wiped out, the value of horses greatly depreciated, if indeed the breed did not become extinct.

Frightful locomotives, emitting a breath more poisonous than the famous dragons of old, rushing and tearing through the country, would prevent cattle from grazing and hens from laying. The terrible smoke would darken the sun. Crops would cease to flourish. Sparks would set fire to barns and haystacks. In short, the pursuit of agriculture would be impossible. Land would be thrown out of cultivation; land holders and farmers reduced to beggary. Cows would refuse to give milk. Sheep would starve. The poor rates would be increased in consequence of thousands of persons being thrown out of employment, and all that a few manufacturers and shippers might enjoy a gigantic monopoly in railroad traffic. We have only to substitute oleomargarine for railroads in these false phophecies, and we have the arguments of the butter makers to-day.

In the sixteenth century many improvements were made in the art of dyeing. It was found that cloth could be colored, not only better, but cheaper, with indigo brought from the East than with the native dyes according to the older methods. But there were many farmers in France and Germany engaged in the cultivation of pastel, a plant then largely used in all the dyehouses of Europe. They got up a farmers' panic and developed a tremendous opposition to indigo. The enemies of indigo, like the enemies of oleomargarine, well knew how much prejudice attaches to a name, and so they declared indigo to be "a pernicious, deceitful, eating, and corrosive substance." They called it the "devil's dye," just as oleo agitators now talk of "bull butter" and "hog's blubber." They demanded legislation, and they got it.

An imperial edict was issued against indigo in 1654, on the ground that by its use "the trade in pastel was lessened, dyed articles were injured, and money carried out of the country." In Nuremberg they made a law that every dyer should take an oath not to use indigo. Henry IV. of France, in 1609, ordered that the punishment of death should be inflicted upon all who used the "false and pernicious drug called indigo."

I might multiply these illustrations of selfishness and ignorance. History is full of them, and the final result has in every instance been the same. Useful improvements have always made their way in spite of coercive measures, in spite of class interests, in spite of derisive names. Oleomargarine is no exception. Its production is founded on the immutable principles of science, and those who oppose it might as well make up their minds that it has come to stay. Let those who doubt it look back over the pages of history, reading the lessons of past experience, and they will learn how narrow and selfish their present position will appear to those who, in future years, read with surprise the story of their factious opposition to a beneficent improvement, which, being useful, must inevitably become common.

NO MORE CLASS LEGISLATION.

We do not want, nor will we have, if we can help it, any more legislation for classes or corporations. We want neither land, railroad, nor banking monopolies. The farmers will have to concede that there are other people and other interests than theirs. We do not want trusts to put up the price of flour or sugar, and we do not want legislation intended to bolster up the market for poor butter for the exclusive benefit of butter speculators. Oleomargarine, as now made, is a cleaner and every way a more reliable product than much of the butter on the market. It has the same food value as butter and is sold at half the price. The time has gone by in Massachusetts when a small minority of farmers will be allowed to say to the laboring classes, "You must eat our butter or nothing."

I know that the disclaimer has been made of any desire to prohibit the honest sale of oleomargarine; but every proposition which has, year after year, been made to this committee looking to a still more stringent enforcement of the present law—recommendations made by officers charged with its execution—has been thrown out. The agricultural committees of past years have refused to take any suggestions unless these amounted to practical prohibition by making oleomargarine objectionable in appearance. Dr. Harrington, the present milk inspector of the city of Boston, appeared before this committee and asked for precisely the same legislation as I had asked for, three years successively. The petitioners have always opposed any suggestions in addition to present requirements calculated to compel oleomargarine to be sold for exactly what it is, because they want to come here, year after year, and say: "The present law is not perfect and we want something else." That something else is prohibition. They know they cannot hope to get that, and so they endeavor to arrive at practically the same result by trying to make oleomargarine distasteful to its honest consumers by coloring it red or black, or requiring that it shall not be yellow, as it always has been. A member of the committee said to me last

* An address before the Committee of Agriculture, of the legislature of Massachusetts, on a petition for the further regulation of the sale of oleomargarine, January 24, 1890.

year, "If we can't get what we want, we don't want anything."

COMPOSITION OF OLEOMARGARINE.

What is this oleomargarine in regard to which there is so much agitation? It is simply natural fats combined in such a way as to produce an agreeable and healthful food. Every one of its constituents, when in a separate form, is used as food, and every constituent is recognized as healthful. When united, these various fats form a compound containing every constituent found in butter. The only difference between oleomargarine and butter is due to a small percentage of flavoring substances, natural to butter, but present in less amount in oleo.

Ninety per cent. of butter consists of bodies identical with oleomargarine. Oleomargarine lacks only five per cent. of the flavoring substances found in butter. The stearine of butter is identical with the stearine of other fats. The oleine of butter is identical with the oleine pressed from tallow. Oleomargarine is often spoken of derisively as grease. This is true. Oleomargarine is grease, but butter is the same thing. We may separate from butter a white solid stearine and a fluid oil which cannot be distinguished from the same bodies obtained from other fats.

[Specimens of stearine and oleine obtained from butter were exhibited to the committee. In appearance, taste, smell, they were the same as in these principles obtained from any other source.]

Oleomargarine is not, as it is often called, "imitation butter," it is artificial butter. It has the same relation to butter that manufactured fertilizers have to stable manure. This is no doubt an ideal fertilizer, but there is not a sufficient amount produced to restore the fertility of the thousands of acres of worn-out fields which the farmer cultivates. The science of chemistry steps in and finds out the compositions of manures, determining what constituents are essential, and their proportions.

It then gathers together the various bodies which compose it and makes an artificial fertilizer. It finds in South Carolina the phosphate rock. It brings from the mines of Germany compounds of potash. It takes the refuse of the gas works, and from the offensive tarry products it obtains ammonia. These are combined in the same proportions as they exist in stable manure, and the result is an artificial product having all the essential properties necessary to the food of plants. So with oleomargarine. The chemist has analyzed butter and determined the proportions of the various bodies which compose it. He then takes these identical bodies from various natural sources and makes an artificial butter having all the essential properties of natural butter. The agriculturist accepts the truth of chemistry in everything else but in the making of oleomargarine. The day will come when he will be forced to admit that chemistry can produce artificial butter.

FOOD VALUE OF OLEOMARGARINE.

For all purposes as a food; for keeping up the natural warmth of the body; for giving strength to the arm and power to the muscle, there is little difference between oleomargarine and butter. If there is any difference, it is in favor of oleomargarine. When the laborer sits down to his daily meal, he and his children find the same nutriment, the same strength-sustaining quality, the same power of warmth in oleo that they do in butter, and they are able to obtain it for half the money. This is oleomargarine—made under government inspection. No unclean or unhealthful ingredient possible in its composition; the government stamp a guarantee of its purity. Made by no secret process, protected by no patents; the factories everywhere open to public inspection, and the healthfulness of the product certified by every leading authority in the world.

OPINIONS OF LEADING SCIENTISTS.

Let me read you what has been said of oleomargarine by some of the most noted scientific men in the United States:

Prof. C. F. Chandler, professor of chemistry at Columbia College, N. Y., says: I have studied the question of its use as food, in comparison with the ordinary butter made from cream, and have satisfied myself that *it is quite as valuable as the butter from the cow.* The product is palatable and wholesome, and I regard it as a most valuable article of food.

Prof. George F. Parker, of the University of Pennsylvania, says: Butterine is, in my opinion, *quite as valuable as a nutritive agent as butter itself.* It is perfectly wholesome, and is desirable as an article of food. I can see no reason why butterine should not be an entirely satisfactory equivalent for ordinary butter, whether considered from the physiological or commercial standpoint.

Prof. Henry Morton, of the Stevens Institute of Technology, New Jersey, says: I am able to say with confidence that it contains nothing whatever which is injurious as an article of diet, but, on the contrary, *is essentially identical with the best fresh butter, and is superior to much of the butter made from cream alone which is found in the market.* The conditions of its manufacture involve a degree of cleanliness and consequent purity in the product, such as are by no means necessarily or generally attained in the ordinary making of butter from cream.

Prof. S. W. Johnson, Director of the Connecticut Agricultural Experiment Station, and Professor of Agricultural Chemistry in Yale College, New Haven, says: It is a product that is entirely attractive and wholesome as food, and one that is *for all ordinary and culinary purposes the full equivalent of good butter made from cream.* I regard the manufacture of oleomargarine as a legitimate and beneficent industry.

Prof. S. C. Caldwell, of Cornell University, Ithaca, N. Y., says: While not equal to fine butter in respect to flavor, *it nevertheless contains all the essential ingredients of butter,* and since it contains a smaller proportion of volatile fats than is found in genuine butter, it is, in my opinion, less liable to become rancid. It cannot enter into competition with fine butter, but so far as it may serve to drive poor butter out of the market, its manufacture will be a public benefit.

Prof. C. A. Goessmann, of Amherst Agricultural College, says: Oleomargarine butter compares in general appearance and in taste very favorably with the average quality of the better kinds of dairy butter in our markets. *In its composition it resembles that of ordinary dairy butter,* and in its keeping quality, under corresponding circumstances, I believe it will surpass the former, for it contains a smaller percentage of those constituents which, in the main, cause the well known rancid taste and odor of a stored butter.

Prof. Charles P. Williams, Professor in the Missouri State University, says: It is a pure and wholesome article of food, and in this respect, as well as in respect to its chemical composition, *fully the equivalent of the best quality of dairy butter.*

Prof. J. W. S. Arnold, Professor of Physiology in the University of New York, says: I consider that each and every article employed in the manufacture of oleomargarine butter is perfectly pure and wholesome, that *oleomargarine butter differs in no essential manner from butter made from cream.* In fact, oleomargarine butter possesses the advantage over natural butter of not decomposing so readily, as it contains fewer volatile fats. In my opinion, oleomargarine is to be considered a great discovery, a blessing for the poor, and in every way a perfectly pure, wholesome, and palatable article of food.

Prof. W. O. Atwater, Director of the U. S. Government Agricultural Experiment Station at Washington, says: It contains essentially the same ingredients as natural butter from cow's milk. *It is perfectly wholesome and healthy, and has a high nutritious value.*

Prof. Henry E. Alvord, formerly of the Massachusetts Agricultural College and President of the Maryland College of Agriculture, and one of the best butter makers in the country, says: The great bulk of butterine and its kindred products is *as wholesome, cleaner, and in many respects better than the low grades of butter* of which so much reaches the market.

Such is oleomargarine—healthful, nutritious, fully equal to butter in food value, and sold at half the price. It would seem that an invention of this character, which tends to diminish the cost of living and lessen the burdens of the toiler, was entitled to the encouragement of the State and nation. But no. The dairy interests, guided by selfish impulses, have everywhere invoked the power of national and State governments to crush out this new food product, hoping thereby to prevent competition, and to raise the price of butter.

THE UNITED STATES REVENUE LAW.

Influenced by the clamor of butter speculators, and especially those who handled the lowest grade of butter, by the wholesale lying of a few so-called agricultural newspapers, and by a sort of farmers' panic skillfully worked up by those who had personal ends to serve, certain congressmen, setting policy and votes above conscience, passed an infamous tax bill, the avowed purpose of which was to crowd oleomargarine to the wall. They are willing to allow a man to sell poisonous whisky under a retail tax of $25, but a dealer in pure and healthful oleomargarine must pay twice as much. A man can manufacture poor rum or "Jersey lightning," by paying a tax of $100, but the manufacturer of cheap food must pay $600. Manufacturers and dealers in a wholesome food product—cheaper and better than the butter commonly sold—are compelled to pay a tax from two to five times as great as that levied upon an occupation that is crowding our prisons and supplying candidates for the gallows. Butter men seated around this room advocated and promoted this disgraceful legislation. They compelled every housekeeper whose circumstances influenced him to prefer oleomargarine to butter to pay a tax equivalent to three cents per pound upon every particle of it which he consumed. They were disappointed that they did not make the tax ten cents per pound. Farmers talk of excessive taxation, but caring nothing for millions of laborers in other fields whose hardships are tenfold greater, they were willing to impose this burden, because they believed that thereby butter would sell at an increased price of five cents per pound. This is the ultimate object aimed at in the legislation on this subject which is asked of this committee. Well, Mr. Chairman, the butter merchants and the dairymen got their bill—this revenue tax bill intended to kill oleo. They said it was all they wanted. Even the fiery *Homestead,* in an editorial paragraph (July, 1886), asserted that the "bill made suitable and reasonable provision to compel the sale of oleomargarine in its true guise and upon its own merits. The law," it said, "will drive out impostors, protect producers of pure butter from the enemy that competes only by fraud and deceit, and will *guarantee* customers of the character and quality of the product." And in another place it said: "The bill is so carefully drawn that the dishonest can hardly hope to evade it."

THE MISTAKE OF THE BUTTER MEN

The bill became a law in July and was to take effect in November. Butter makers greatly increased their production, and butter speculators laid away large stocks in anticipation of a rise. But they were deceived as to the truth of the situation, and the crash came. The price of butter at Elgin during the winter of 1886–87 averaged 25 per cent. less than it had before the passage of the oleomargarine bill. The exaggerated reports about the production of oleomargarine and its effect upon the butter market had misled hundreds of butter makers and butter dealers, and in the losses which they sustained in the winter of 1886 and 1887 they reaped the results of the falsehoods told by those whose selfish leadership they had blindly followed.

Contrary to the hopes and expectations of its enemies, oleomargarine did not die. It had a merit which neither abuse, misrepresentation nor unjust legislation could kill. The revenue tax law, designed and intended to crush the new industry, notwithstanding its oppressive taxes, proved a boomerang of the heaviest sort, and instead of injuring oleomargarine, it has, under the efficient administration of the revenue department, in many respects been of substantial benefit to manufacturers, dealers, and consumers. As a recent writer has said: "When a dealer offers to his trade rancid, sour, or cheesy butter, it is now impossible for his customer to accuse this stuff of being oleomargarine. The buyer knows that the vigilance and care of the officers of the government protect him from buying oleomargarine without the proper brand upon it. In such case the blame goes directly where it belongs, namely, to the slovenly butter maker."

The *Dairy World*, an agricultural journal of wide circulation and influence, last year published an article as follows: "This law was designed to entirely prohibit the manufacture and sale of oleomargarine, and as a prohibitory enactment has proved a signal failure. Why? We think it is because oleomargarine possesses considerable merit, and that the investigation before Congress brought its better qualities prominently before the public. This legislative agitation has educated the people, and the government stamp has proved to be an official certificate of its healthfulness, and not a badge of dishonor."

The United States statute has now been in full operation for more than three years, and according to its strict requirements, oleomargarine has been sold under its true name. Ladle-packed butter, its chief competitor, has in the meantime continued to profit by the dishonest brands of "dairy" and "creamery" which are almost universally put upon it, yet the results of this competition have been such that the friends of oleo are quite content to abide the issue of that universal law which provides for the survival of the fittest.

MISREPRESENTATIONS CONCERNING OLEOMARGARINE.

The dealers in low grades of butter, who have always been at the bottom of all this agitation, have got down to their last ditch. For years they have waged a desperate and uncompromising warfare against a product which the public is fast discovering to be more desirable than theirs. They and their allies until within a short time have, by every possible misrepresentation, sought to prejudice the public against oleomargarine on the ground of healthfulness. One gentleman—a Boston butter dealer—who has always been in the front rank of the opposition to oleo, said to a committee of the United States Senate that "every conceivable grease of the very filthiest kind in our country is manufactured into imitation butter and sold to customers." He said, also, that it was a principal cause of Bright's disease. [Testimony of S. P. Hibbard, 49th Congress, Sen. Miss. Docs., No. 131, p. 30-31.] I remember the speech of another gentleman in the Massachusetts Senate—a few years since. This gentleman said that oleomargarine "contained the germs of cancer." Others have called it "nasty and unwholesome;" "a compound freighted with disease;" "producing insanity;" "the product of the charnel house;" "the slag of the butcher shop;" "a compound of diseased hogs and dead dogs." These are some of the delicate expressions which these gentlemen have applied to a product which the Massachusetts State Board of Health, in response to a special inquiry of the Massachusetts Senate, declared to be "a good, healthful article of food, and much better than the poorer grades of natural butter."

The loathsome lying of the cheap butter dealers has come to naught, and they long ago acknowledged defeat on the health issue and abandoned their guns. They come here to-day and admit the healthfulness of oleomargarine, and thereby admit the falsity of what they said in this very room, only a year or two ago.

THE COLOR QUESTION.

As I have said, the revenue tax law, so far as the prohibitory results intended by its framers are concerned, has proved a dead failure, and so, again driven from their intrenchments, the enemies of oleo have fallen back, determined to make one last effort, and have rallied under the painted yellow flag of colored butter. They claim a trade mark in nature's yellow—a pre-empted right to so-called butter color. This is the issue to-day.

This claim, like so many others which the butter makers have rashly made, has no foundation. The *usual* color of edible oils and fats is yellow, *as* yellow as any butter. Centuries ago the tables of the patrician Roman were served with golden yellow oil of the olive, while butter, not then used as food, was employed only for certain medical uses, and principally for greasing the bodies of athletes previous to their wrestling contests in the arena of the Coliseum. The fat of beeves, enriched by the same fodder as that given to milch cows, is yellow. The rich oil which rises on the broth of chicken or boiled fowl has a deeper color than ordinary butter. Cotton seed oil, so largely used in the South for food, and by us for salads, has a brilliant yellow color, and oleomargarine prepared from cotton seed oil or peanut oil and beef suet in the summer time is as yellow as if not yellower than is ordinary winter butter. Shall it be said that the manufacturer of oleomargarine has not the right to the natural color of his own product?

But it is said that the oleo maker *adds* color to his product, making it thereby yellower than it is naturally. This is true, but has he not the same right to do so as the dairyman? and especially in view of the fact that the dairyman's cotton seed oil color, as he now uses it, was invented by the oleo maker? The first man to dissolve annatto in cotton seed oil for a butter color was the oleomargarine manufacturer, while the dairyman never used oil color in his butter until after he had been shown how to do it by his competitor. The butter maker whose poorly fed cows gave white butter, used carrots and safflower, and he had employed various alkaline solutions of annatto, which colored the buttermilk, but he never knew that the best color was an annatto-cotton-seed-oil color until he had learned it from the maker of oleomargarine. And now the butter makers claim the exclusive right to appropriate this invention.

OLEOMARGARINE COLORED FOR THE SAME REASON AS BUTTER.

It is said that the oleo maker colors his butter in order to deceive. I deny it, and assert that he colors his goods for exactly the same reasons as the butter maker, and that there is no reason for coloring applicable in one case which is not equally applicable in the other. Why is butter colored? The reply usually given is: "To please the eye, and make the product of different churnings uniform in color and appearance." Assuming this to be true, and waiving the question of deception, if there be one, involved in butter coloring; the concealment of poor quality, making dry feed winter butter appear like a grass-fed June product—waiving these matters, and assuming the reasons given for coloring butter to be correct, has not

the oleo maker the right to make *his* goods attractive in appearance? Has he not the right to make his product, the product of different days and of varying materials, of a uniform color? Has not the poor man and the man in moderate circumstances the same right to have his oleo made "pleasing to the eye," as the millionaire, whose æsthetic tastes are offended unless his winter butter has the color of "Jersey"?

WHAT BUTTER COLOR DOES.

Let me read you what is said of butter color by those who use it. I hold in my hand a circular issued by a leading manufacturer of butter color wherein he gives a large number of letters from customers in recommendation of his product. This testimony is interesting, and it must be true, for it all comes from the makers of "honest butter."

Extracts from a circular of Wells, Richardson & Co., entitled "Gilt-edged butter. How it is made. Letters from prominent dairymen."

"Your improved butter color cannot be excelled. I cannot see that it makes any change in the flavor of the butter, but even if it did not persons would naturally think that it did, *for yellow butter seems to taste better than white*, and of course it goes into the market better." WILLIAM MOORE, Oronoque, Kansas.

"We are more than satisfied with your improved butter color. Winter butter colored with it commands a higher price, for it looks and tastes like butter made in the months of May and June."
MRS. JAMES COLLINS, North Amherst, Mass.

"I took a jar of butter to the store, but it was so white and lardy-looking the storekeeper would not make me any offer for it. The other day I took some colored with your improved butter color, and he paid me the highest market price."
MRS. J. W. LAWRENCE, Moscow, N. Y.

"Our winter butter will bring from three to five cents per pound more in the market by using your butter color; and as a fifty cent bottle will color 1,250 pounds, it makes it quite an object for dairymen to use it, for allowing that it brings only three cents per pound, in selling 1,250 pounds it puts in our pockets thirty-seven dollars more than it would with it left out."
GEORGE W. HOWE, Middlefield, Mass.

"Several of my neighbors said they would not use anything to color their butter, but when they had to sell their butter for fifteen cents per pound, and I was getting twenty-five cents, they changed their minds and are now using the improved butter color."
MRS. H. P. DUNHAM, Lenexa, Kansas.

Now, Mr. Chairman, for the purpose of this argument it is unnecessary that I should go into any discussion of the morality involved in the coloring of butter, but I submit that if a handsome and agreeable color in butter adds to its market value five cents per pound; if such butter is salable, and white butter is not, or not so readily salable; if colored butter somehow or other tastes better, or we think it does, than uncolored butter—then it is likewise true that handsomely colored oleomargarine is more desirable and more palatable than when it has the pale straw color of its natural condition. If it is right to color butter—I do not say it is—but if it is right to color butter, and this coloring is allowed, there is no good reason in all fairness why a rival product, which is actually better, cleaner, and purer than much of the so-called butter, should not be put upon the market in as handsome and inviting an appearance as the skill and science of its manufacturers enable them to make it. Nobody will dispute this proposition but a butter Pharisee, who thanks God that he is not as other men are, but colors his butter with oil and annatto, while condemning their use by others.

ALL COLORS OBJECTIONABLE IN FOOD.

For myself, I do not believe in coloring any article of food. I do not believe in coloring white wine vinegar so it may look as if made from cider. I do not believe in putting turmeric or saffron into baker's cake to take the place of eggs. I do not believe in adding ten years to the age of brandy by the aid of a few drops of Bowker's caramel. I do not believe in making skim milk into "Jersey" by the addition of annatto, and I do not believe in painting poor winter butter with the fresh grass tint of early spring. I do not believe in coloring oleomargarine. I am in favor of stopping all this coloring. Let poor butter be left uncolored, so that we may see just how poor it is. Let oleomargarine be sold only in its natural color. I am in favor of all these things, but in common with every fair-minded person, I am opposed to legislation which as between poor butter and oleomargarine, discriminates against the better product, because this is the very height of unfairness and class legislation of the rankest kind.

OLEOMARGARINE SOLD HONESTLY.

But it is said that oleomargarine, as generally sold, is fraudulently represented to be butter; that it cannot be sold on its merits, and therefore some legislation in regard to color is necessary to give warning to the customer, and inform him of the character of the article he is buying. To this end it is proposed to prohibit the addition of any yellow color, and some go so far as to favor a requirement that oleomargarine shall be tinted red or even black. If it were true that oleo was not, and could not, generally be sold on its merits, there might be some justice in the proposed remedy, but, like almost every assertion made by the enemies of oleo, this is absolutely without any foundation in actual facts. Time does not permit that I should consider this statement at any length, but it is disproved by a mass of testimony before this committee and by the official statements of officers charged with the enforcement of laws which compel dealers to sell oleo for what it is and not as butter.

The State Board of Health, charged with the enforcement of the food laws of the commonwealth, say in their report published in 1889:

"The protection afforded to the consumers in this State by three different sets of officers—the internal revenue officials, the inspectors of the State Board of Health, and the local inspectors of cities, has undoubtedly restricted the fraudulent sale of oleomargarine to *very narrow limits.*"

The United States Commissioner of Internal Revenue, in his report for 1888, stated that as the result of a personal inspection in the cities of Massachusetts, he found a constantly increasing number of consumers who bought oleomargarine on its own merits; and in the report for 1889, the commissioner says that it is "*sold on its own merits, and has assumed its legitimate place as a cheap and wholesome food product.*"

Such statements, from those whose business it is to know, must be regarded as conclusive. Further testimony is, perhaps, unnecessary, but as directly bearing on this question, I think a little circular issued by one of the largest retail dealers in oleomargarine in Boston is of great importance. This is the way that dealer advertises. He says: "Have you ever investigated oleomargarine for yourself, instead of trusting to what some self-interested person has told you? If not, we ask you to try it. Take home a pound. Don't tell your family it is butter; tell them it is oleomargarine. Show it to your family physician. Ask his opinion about it. All we ask is a fair show and the truth." When a dealer advertises his wares in this fashion, and when manufacturers advertise their goods in the horse cars, as is done in Boston, it is beyond question that they expect to sell them on their merits.

THE POOR BOARDERS.

I said a moment since that the dealers in low grades of butter had got down to their last ditch. They acknowledge it themselves. They are forced to admit that oleomargarine is healthful, and they reluctantly concede that the dealers almost universally sell it for what it is; but they exclaim triumphantly: "Most of the oleo is sold to boarding houses, and the boarders don't know what they are eating." The returns of the revenue office prove that most of the oleo is *not* sold to boarding houses, but it is doubtless a fact that the unfortunate inmate of the ordinary boarding house always has been, and probably always will continue to be, in blissful ignorance of the occult mysteries of its kitchen. For years the poor boarder has struggled with the hidden secrets of hash and sausage; remnants of veal have masqueraded in the chicken pie, and superannuated fowl have put on the tender innocence of spring chicken.

There are suspicions in the vinegar; doubts in the sugar bowl; grounds of uncertainty in the coffee pot. The homeless victim of the boarding house finds the pepper box and the mustard cup to be a perfect museum of the materia medica; the components of his tea would form a herbarium of indigenous botany. Root crops of every kind do duty in the horseradish bottle. There is copper in the pickles, alum in the baking powder, water or something worse in the milk. Mystic combinations everywhere surround the hungry guest who sits at the boarder's table, so that it is but the simple truth to say that the contents of the butter dish are, like the other viands, obscure in origin and mysterious in composition. The butter may indeed be oleo. It may, perchance, be butter and be something worse. It may be "hash butter," marked by the honest dealer as "dairy" or "creamery"—a mixture of a hundred kinds coming from "camps and dugouts, huts and sheds, mud cabins, coops and barns," all over the West, made "uniform and pleasing to the eye" by much abused butter color. Boarding house butter may not be oleo—it may be pure, but it may also have done duty at many previous meals, and the remnants carefully gathered up and made "pleasing to the eye" by the housekeeper carrying out on a small scale the tactics of the hash butter dealer. There are worse things than oleo in many a boarding house. The spectacle of philanthropy presented by a commission dealer in ladle-packed goods holding the cover of a hash butter firkin marked "creamery," like a protecting shield, over the head of a defenseless boarder, warding off a possible attack of Bright's disease through the antiseptic properties of his own miserable compound, is as ludicrous in its pretensions as it is contemptible in its hypocrisy.

FACTS RELATING TO BOARDING HOUSES.

But coming down once more to hard facts, the census of 1885 showed that there were in the whole State 2,122 boarding houses and 881 restaurants. There were 310,248 dwelling houses, occupied on the average by six persons.

The great majority of the people of Massachusetts are people in moderate circumstances, who keep house. A very small fraction of the people live in boarding houses. The great mass of the New England community are housekeepers, and the great mass of housekeepers are people in moderate or extremely moderate circumstances.

Three thousand boarding houses and restaurants cannot possibly consume the quantity of oleomargarine which the Farmers' League claims is consumed in Massachusetts.

Allowing each boarding house to have, on the average, twenty boarders, and that each boarder required an ounce of butter each day, and assuming that every restaurant and boarding house in the State used oleo exclusively, the quantity would be barely an eighth part of the oleo claimed to be eaten in the State during that time. The argument against oleo based on philanthropic considerations for the boarders is as weak as all the others.

THE QUESTION OF COMPETITION.

The only remaining argument is that based on the question of competition. Massachusetts furnishes a market for 50,000,000 pounds of butter per annum, but her dairymen are unable to supply more than one-fifth of this amount. If oleomargarine were entirely excluded from the State, the competition between the 10,000,000 pounds of butter made in Massachusetts and the 40,000,000 pounds of butter brought into the State from outside its limits would be the same as now.

The total prohibition of oleomargarine in New York State has not prevented the depression of the butter market, which has been the same in New York city as it has in Boston. As has been repeatedly stated, oleomargarine competes only with low grades of butter, not the butter made on Massachusetts farms. This is generally of superior quality and finds a ready sale at twenty-eight or thirty cents or more per pound, as testified here by several of the petitioners.

At a recent meeting of the Readfield Grange, in the State of Maine, as reported in the Lewiston *Journal* of January 2, 1890, Mr. R. W. Ellis, of the Board of Agriculture, dwelt at considerable length on the profits of the dairy. He stated he could make butter for thirteen cents per pound. Among hundreds of prominent butter makers whom he had met, no one claimed that it cost over fifteen cents. It may be made, however, to cost more than is received for it. He thought there was no danger of overdoing the dairy business in Maine. That State, he said (and the remark is still more applicable to Massachusetts), "did not make anywhere near butter enough to butter her own bread." Thus it appears that the butter maker selling his goods direct to customers, as most Massachusetts dairymen do, gets a profit of from 100 to 125 per cent. Is not this sufficient? As was stated by Mr. Ellis: "If any manufacturing business paid as much profit as butter making, men of means would rush into it by the thousands."

The conclusion of the whole matter is this: A large class of people want oleomargarine. They buy it knowingly and from choice, because it is cheaper and better than any butter sold at prices within their means. They have always had yellow oleo, and they have never seen it of any other color. They have seen it of this color for more than ten years. They still want their oleo yellow, because that is the color to which they have become accustomed and because yellow is the common color of edible oils and fats. They do not want it to look white like tallow, any more than the butter consumer, who does not fancy white butter, even though he has made it himself and knows it is pure. Consumers of oleo do not want their artificial butter to be made the color of lip salve, or blue like mercurial ointment, or of the complexion of shoe blacking. They have the same right to eat yellow oleo that they have to sit down to a pine table painted in imitation of black walnut or to use silver-plated teaspoons.

The whole opposition to oleomargarine originates in unadulterated selfishness. It is not fraud which troubles the conscience of the dealer in poor butter. Many of his own goods are dishonestly branded. It is not solicitude for the public or consideration for the boarders which animates the greedy butter maker. It is the fear—an ungrounded fear, so far as it concerns fine butter—but a fear nevertheless of competition, and a belief, equally erroneous, that with oleo out of the way, or made objectionable in appearance, butter prices would be higher.

OLEOMARGARINE COMPETES ONLY WITH POOR BUTTER.

As a recent writer has said: "Give oleomargarine a fair field and equal rights, and it will drive common and dirty and badly made butter out of the market, and it will drive the speculators and the would-be cornerers of the butter market out of existence." The farmers of Massachusetts, properly informed of the real state of facts, will cease to be troubled by the oleomargarine question. Let me read you in conclusion a short extract from an address to farmers, made at a meeting of farmers, by Mr. James Cheesman, secretary of the New England Creameries Association. Mr. Cheesman says: "Oleo does not compete with good butter. The goods that are injured by its rivalry are the product of men who don't understand their business. The men who show most hatred toward this substance are those interested in the sale of ladle-packed goods, or hash butter. These goods are packed by storekeepers in the West, and shipped East to depress the butter market. Kept in refrigerator cars and cellars in Eastern cities, the process of deterioration is arrested till the goods reach the consumer under some fancy name of 'dairy' or 'creamery,' or whatever the fertile brain of the salesman may suggest. These goods and not oleo do more to depress your business in the city of Boston and adjoining cities than anything else." If the farmers would do a little investigation on their own account, they would cease to be the cat's paw of butter speculators or the dupes of demagogue newspapers. Agricultural politicians would find their occupation gone. If they were elected or appointed to some office, it would be on the ground of fitness or ability, and not because they were sound on the butter question. I will not trespass further upon your time, but close with the admonition: "Prove all things. Hold fast to that which is good." I believe that oleomargarine is good. I believe it has come to stay, and I believe it will stay yellow. When the day comes that the butter people, and particularly the hash butter manipulators, are willing to put their goods upon the market in their natural colors, the oleomargarine manufacturers will meet them on equal ground, and will cheerfully agree to the abolition of all artificial color, confident that the intrinsic merit of their products will insure their continued growth in the good opinion of the masses.

OPTICAL TELEGRAPHY.

THE flashing of a message from Mt. Reno to Mt. Graham, 125 miles, by aid of the heliograph, marks the greatest achievement in this method of optical telegraphy yet made. It is, perhaps, not generally known that the Signal Service Department has been making extensive experiments in this direction for several years, and it may now lay claim to having the longest and most complete heliographing line in the world. Its operations extend from Fort Stanton, in New Mexico, to Whipple Barracks, in Arizona, more than one thousand miles, with ramifications leading in different directions. The terminal stations, twenty-five or more, connect with the general telegraph systems of the country, bringing the almost impenetrable reserves of New Mexico and Arizona into direct communication with civilization or the governments. The system is of immense advantage in Indian warfare, where ordinary telegraph lines have not penetrated, and where they could not be maintained in case of hostilities, were they set up. General Greely recently sent a dispatch to Washington from Bowie Peak, Arizona, the message being flashed from peak to peak, over gaps of forty-five miles, touching at Mt. Graham, Table Butte, Saddle Peak, Pinal Mountains, Lookout Peak, Baker's Butte, Squaw Peak, Bald Mountain, to Whipple Barracks, from where it was transmitted by the ordinary system. The possibilities of the heliograph are not limited, however, to the 125 mile record, and, understanding its value from a military point of view, the Signal Service Department will not fail to develop it as far as possible. The heliograph is a sim-

ple little instrument and easy of manipulation. A small mirror is set on a tripod in such a manner that the rays of the sun reflected from its surface may be thrown in any direction and kept at the point desired by mechanism compensating for the rotation of the earth on its axis. These rays, interrupted so as to show flashes of long or short duration, representing the ordinary Morse alphabet, are watched and their variations noted at the distant station.—*Boston Transcript.*

THE WARRIORS OF BRITISH NEW GUINEA.

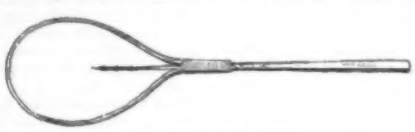
By Lieut. B. BADEN-POWELL, Scots Guards.

OF all the countries in the world, or certainly of all English colonies, probably the least known is New Guinea. Thirty years ago the very coast line was unknown; the exact shape was only made out fifteen years

WARRIORS OF NEW GUINEA.

ago. But now civilization is steadily spreading to its shores, white men are established in the land, and the British government has its officials permanently located. But even now we know but very little of the interior, and there are but two or three ports on the coast where a white man would care to land unarmed. One of the chief causes of this backwardness of so large and promising a land is the treacherous hostility displayed by the natives.

Already a large number of Europeans have met with their deaths at the hands of the natives along the coast, and, while hoping for the best, we cannot be blind to the probability that more white men will have to lay down their lives before these savages have been sufficiently taught that murder is with us considered a



A MAN CATCHER.

crime. There are many different reasons given by natives for their attacks on intruders—coveting their possessions, alarmed at their intentions, mistaking their meaning, or simply, as is sometimes the case, for the sake of killing a man and keeping his head as a trophy. Besides, there may or may not be cannibalism; but it is certain that with some tribes, at least, only the bodies of enemies killed in action are eaten, and some (if not all) will not touch white man's flesh. Under these conditions troubles between races are sure to occur, and British magistrates and British forces will be called upon to punish murderers and would-be murderers, and to interfere in quarrels between local tribes. It thus becomes a necessary as well as interesting study

STONE CLUBS AND DAGGER.

A BARBED SPEAR.

to inquire into their means of offense and defense, and I write from recent personal experience in New Guinea itself.

We need not allude to anything in the way of a large rising—a civil war—since it is very unlikely that anything of the kind would take place in New Guinea, chiefly because the population consists of so many different tribes, each distinct from the other, with totally different language, manners, and customs. A native of one part of New Guinea would be as much a stranger in another part as an Englishman would. It is, therefore, probable that the only kind of warfare which will be carried on between ourselves and the natives will be of a minor kind, merely punitive expeditions, which need not expect any great amount of opposition from the natives themselves, but which, nevertheless, must expect to encounter great difficulties from the deficiency of means of progress and communication, and from being continually open to small and sudden attacks.

One of the most noticeable characteristics of the warriors of New Guinea is their treacherous mode of attack. One may enter a village and be welcomed by a crowd of unarmed men, who will show every sign of friendship; but once they see their opportunity—once the party is dispersed, arms laid down, or some asleep—then in a second the natives are around and rush to the attack. Extreme vigilance must at all times be observed. Then, again, while marching along the tracks through the bush country, natives will readily mark the approach of the Europeans. They will watch their opportunity again; keep some distance ahead of the advancing troops, or move along parallel tracks in the scrub, and make the most of any opportunity of sudden attack, such as during a halt or when the party has become somewhat dispersed. The general method of attack in most parts of New Guinea seems to be that of charging up toward the enemy, and, when within, say, 20 to 30 yards, throwing their long spears. Some of them are wonderfully good shots, and can send their spears through a dog running away 30 yards from them. But spears are not the only arms. In the west of British New Guinea bows and arrows are much used, and are, of course, far more formidable than the spears, as their range is much greater, and the aim much more accurate; the natives practice by shooting at cocoa nuts in the trees. It is probable that neither spears nor arrows are ever poisoned in New Guinea. Another primitive weapon of offense which is sometimes used, especially at the east end, is the sling. A few stones are carried, often nearly as big as one's fist, and these are hurled with a twist of the arm very similar to the action of ordinary throwing (without twirling the sling round over the head as is done elsewhere). The natives seem to vary a great deal in their ability to sling stones, some being marvelously good both in accuracy of aim and in great distance, perhaps 200 to 300 yards; while, on the other hand, many others are very feeble in their efforts. The natives of certain districts possess a most curious instrument, used more for the capture and slaughter of an already vanquished foe than for actual attack. It consists of a stick three feet long, on the end of which is a piece of cane bent round like the iron of a landing net, and of such a size as to easily slip over a man's head. On the end of the stick is fixed a sharp stake, the point of which comes nearly to the center of the cane ring. In chasing a fleeing enemy, the warrior holds out his "man catcher" and puts the cane ring over the unfortunate fugitive's head, when a sudden pull back causes the latter to stop short and fall backward upon the sharp stake, which runs into his neck just at the base of the skull, and he is instantly killed. The only other weapons used are clubs, these being of several varieties. The stone-headed clubs have pieces of beautifully worked stone fixed on the end, either made sharp so as to cut like a hatchet, or carved into a series of spikes. Other clubs are made of heavy hardwood, often made of the shape of a two-edged sword, and are consequently comparatively sharp, and have a certain amount of cutting power.

Some natives use a blowpipe for shooting birds, but it is probably but seldom used as a military weapon. Most of the natives have shields. These are generally of wood, about three feet high by one and a half to two feet wide. They would, of course, be useless against fire arms.

Although the natives of New Guinea are not given, as a rule, to do much in the way of fortifying their villages, yet some of these have been found with a large palisade around them, consisting of saplings firmly planted in the ground two or three inches apart, and secured by a cross bar eight or ten feet above the ground. Entrances are left in this palisade which may be closed by horizontal bars.

One of the many curiosities to be met with in New Guinea are the tree houses. They are used as lookout towers, and also for defense. Many villages have a house built in one of the biggest trees in the village, connected by a ladder with the ground. On the approach of an enemy, the inhabitants retire to this refuge, and are then not only out of harm's way—being above the range of a spear—but also spears and stones, of which a store is kept, can be hurled down upon their enemies from above. These tree houses are used around the palisades above described, as galleries to protect them.

The natives, as a rule, are wonderfully quick at distributing news. There are many means of signaling and making known various facts. The tom-tom is a favorite instrument, as in all uncivilized places. Generally it is played when the men are assembling for a warlike purpose, but not always. It is occasionally used on other occasions. Trumpeting on large shells has a more significant meaning. On the approach of danger, the weird sounds of these horns can be heard for miles around as they are taken up from village to village. Another elaborate system of signaling is by watch fires. Sometimes these are lighted in rows of two or three, and many of the hills have their beacons alight at night. Even the smoke in daytime is said to convey its meaning to those on the lookout.

The means of progress in a country is always one of the most important considerations from a military point of view, and is a most difficult one in New Guinea, where not only are there no roads, but no vehicles or horses, with the exception, of course, of a very few in the immediate neighborhood of the white settlements.

In so large a country, of course, every variety of natural feature may be met with; New Guinea generally may be described as hilly and covered with scrub. All the more thickly populated districts are covered with a network of native tracks, worn or cut through the bush, and of such a width as to allow one at a time to pass. Occasionally the bed of a stream is taken advantage of, which in the wet season necessitates wading; all very well for the bare-legged natives, but to the European most productive of fever, which, as is well known, is most prevalent in all parts of New Guinea. Not only do nearly all Europeans who travel there get attacked sooner or later, but South Sea Islanders, and other blacks imported for labor, seem to fall a prey to it even more quickly. We need not here discuss the causes and treatment of the disease; it is one which doctors do not well understand, and the only real cure seems to be to leave the country.

The climate is, as a rule, tolerably agreeable—hot, of course, but not unpleasantly so, and nights are generally cool. Rain falls in showers pretty frequently at most times of the year, though the rainy season is supposed to be more particularly from December to May. One can generally count on sleeping out at night, though it may be just a bit fresh in early morning and a covering desirable, and one must always be prepared for short damping showers.

Having thus considered the natives and the nature of the country, we may draw some conclusions as to the conduct and organization of a force sent to the country on a warlike mission.

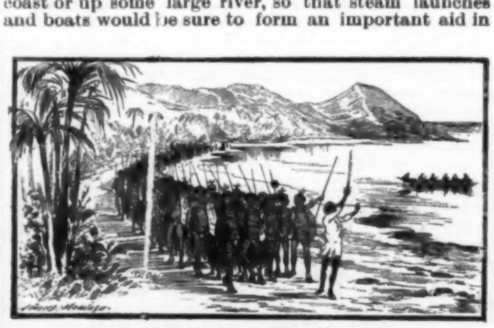
First, we see that the numbers need not be great. A party of a dozen well armed men could go in safety anywhere. But as the object of the expedition would often necessitate a thorough examination of the country, a number of small parties would probably be

TREE HOUSES IN A NEW GUINEA VILLAGE.

the more suitable formation. But then again there are great difficulties about transport. The natives are not given to doing much work, and, as previously explained, most of them would disappear before an invading force. Carriers would have to be specially attached. These might be either natives from other parts of the country (although often very timid of entering strange territory) or from the neighboring South Sea Islands or elsewhere. It would be unadvisable, in so hot and unhealthy a climate, to load Europeans too heavily; and yet too much reliance must not be placed on natives. The best organization would be several small columns, each consisting of an officer or two, a few steady Europeans, and a party of native carriers (women being often the best porters). Probably a few horses could be imported, which would greatly aid the transport. The force, acting in such small parties, and in such difficult country, would necessarily have to be well disciplined to be kept in hand at all. Each man should be thoroughly reliable, certain to keep his watch faithfully at night, able to take care of himself if separated, using tact with the native carriers, etc.

As most probably fighting would be sharp and sudden and at close quarters, a magazine rifle would be best; long range would seldom be necessary, and the natives would not be likely to do much in the way of fortifying themselves, except by getting into their tree houses, which are easily pierced by bullets. A few mounted men in small parties might be very valuable for rapidly driving the natives away and hunting them down, although, of course, as a rule, their progress would be much impeded in the narrow tracks. Means of communicating between the different bodies of the force would be most necessary; and whistles, heliographs, flags, signal lamps, and rockets should be taken.

The operations would in all probability be near the coast or up some large river, so that steam launches and boats would be sure to form an important aid in



AN ARMY ON THE MARCH.

transport, as well as for patrolling and chasing native canoes.

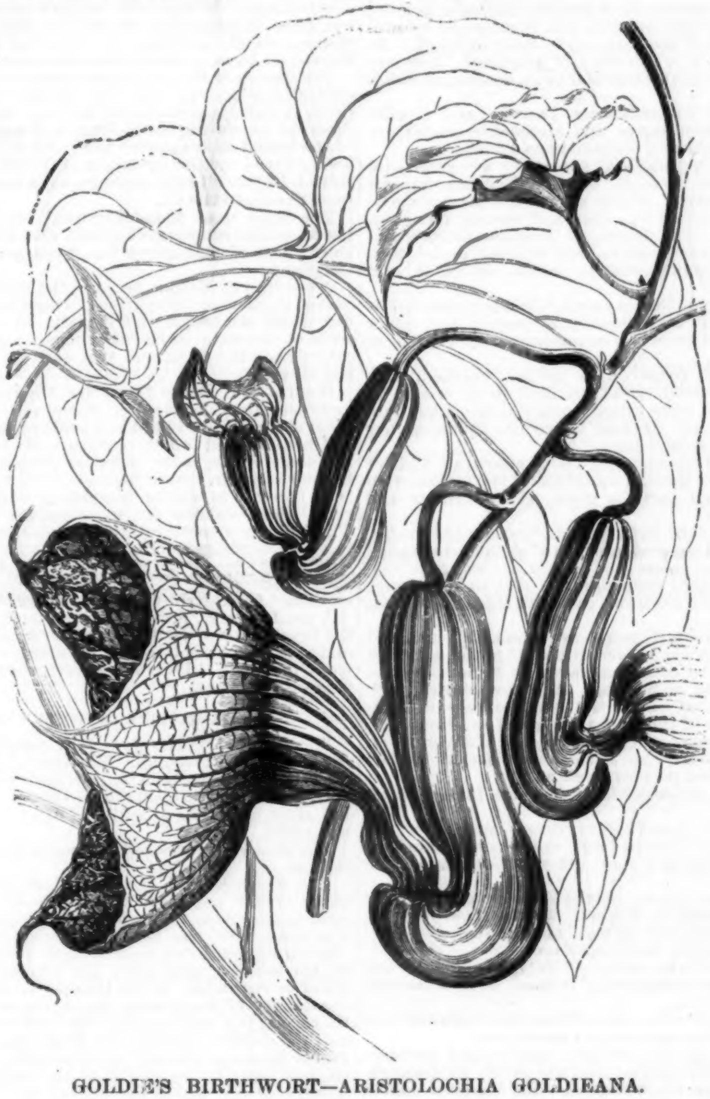
It may be as well to briefly refer to the geographical position of the country. Roughly speaking, the known portion of British New Guinea consists of a strip of coast land some 800 miles long. Port Moresby, the capital and seat of government (although a very primitive place), is about half way along, and possesses a fine harbor. At the extreme east end is a small island, Samarai, where there is good anchorage and some stores with a supply of coal. At the west end there is no port or occupied place; but it is easily reached from Thursday Island in Queensland, where all supplies are obtainable. Several islands, on which settlers or missionaries are established, might form convenient bases, and there are several good, though little explored, harbors.

All kinds of supplies could be sent up from Brisbane or Sydney to any portion of the colony in a week. Here also a well organized force could be raised from the local troops, many of whom are good bushmen and accustomed to hard work in the tropics. But let us hope that their services will not be required, and that New Guinea will peaceably settle down into an orderly and prosperous colony.—*Ill. Nav. and Mil. Mag.*

GOLDIE'S BIRTHWORT.

Aristolochia Goldieana.

HAVING announced the flowering of this interesting plant recently in the Royal Gardens, Kew, we have thought it advisable to again bring it under the notice of our readers, because it happens to be one of the few gigantic beauties that may be grown in any garden where the warmth of a stove is at command. The aristolochias are not in any special degree popular, and the "giants" of the vegetable kingdom are not in favor as subjects suited for cultivation in gardens generally. We should not, for example, recommend the titanic amorphophallus, or the rafflesia or welwitschia for addition to any amateur's choice collection, but the plant before us may be grown in a ten-inch pot, and will flower sufficiently often to pay for the attention it requires, and, all things considered, it might be pronounced a quite "proper" plant; for a stove of moderate dimensions, wherein room can be found for a few curiosities of more than average interest. As the flowers of this plant are exquisitely beautiful—far beyond the suggestion of the best figures that have appeared—and measure over a foot in diameter at the margin of the limb, it must certainly be entered in the list of "wonderful" things that one can afford to wait for a reasonable length of time, and will not soon forget when the gratification has been secured of a display of its floral capabilities. The plant so admirably flowered by Mr. Watson at Kew might, as we remarked at the time, have been crumpled up into a man's hand, although the flower must rank with the largest that nature produces.—*The Gardeners' Magazine.*



GOLDIE'S BIRTHWORT—ARISTOLOCHIA GOLDIEANA.

MUSHROOM CULTURE.

THERE has been lately a good deal of discussion in the pages of the gardening press on the interesting subject of mushroom growing, and as the opinions therein expressed are somewhat diversified and conflicting, I am induced to offer a few remarks with reference to my own actual experience.

I altogether waive the scientific part of the subject. I will leave that to others, preferring to stick to the practical part, as one best calculated to be of tangible benefit to growers in general. I give the following account of my procedure, with the one simple object of perchance being of some little help to those who may possibly have sometimes failed in their attempts to produce paying crops of this much coveted esculent, believing as I do that a free circulation of opinion and more especially of actual experience and results among English growers, not only on the subject of mushrooms, but on all other matters connected with the market produce of garden and glasshouse, would at least assist in stemming the flood of foreign importations, and thus benefit the hard working British growers.

I am a grower of mushrooms for market on a moderate scale, and have no reason to complain of want of success hitherto in a pecuniary point of view. I have no properly constructed houses, but grow the mushrooms on the floors of unheated sheds in summer, and in the paths of my glasshouses all the year round, and the following includes my *modus operandi.*

Preparation of Manure.—This I procure in large quantities at a time, or say I have four empty beds that I wish made up, I procure the manure for these all at one time, and just as it is thrown from the stables. This I throw into a heap in the open air, without removing a single straw, no matter how rough and strawy the mass may be. This heap I turn, on an average, three times a week, and it is exposed during the time to all weathers. If the heap be very rough and strawy, it will be sure to heat dry and white, especially if no rain falls during the process of turning and "making." In this case I add water freely during the act of turning, which assists in the making. During high winds the process of heating is retarded, and when this occurs I tread the heap hard down, and shelter the weather side with boarding, which I have always at hand. The process of making, if the dung is long, generally occupies about four weeks; if shorter, about three. When the dung, from the effects of turning and watering, becomes moderately short, brown-colored, hot, and moist, but not wet, it is ready to be put into the beds.

Making up the Beds.—These I fill up to a depth of 12 inches with the prepared dung. The mass is well shaken up as it is brought into the house, and as evenly laid down as possible, and is then at once trodden down firm; the depth of dung, when hard trodden down, will usually be about 9 inches. I consider this quite enough, and any more merely a waste of manure. I can remember once running rather short of dung, and forming a bed that, when trodden down, was not more than 6 inches thick, and it did quite as well as the thicker ones put down at the same time.

Spawning.—My rule is to insert the spawn the moment I find the heat is not on the rise, which I find out by the thermometer, but I do not hesitate to spawn in a good strong heat, believing that to be much better than to allow the beds to fall to anything like a low degree of temperature. I use the spawn in goodly pieces, and at the rate of about 1 bushel to 50 square feet. These pieces are tucked in, as it were, under the dung with the aid of pointed pieces of iron three-fourths inch in diameter and about a foot long. With such instruments the work of spawning can be got through very rapidly.

Soiling the Beds.—This work I perform the moment the beds are spawned, putting on a layer of about two inches in thickness when rammed down, which is done at once. I use fresh loam when I can get it, but when not procurable I use ordinary garden mould, and after an experience extending over some years, I must confess that so far as regards the quantity of mushrooms produced, the one kind of soil seems to be quite as efficacious as the other. The only advantage maiden mould has over ordinary garden soil is that it produces fewer weeds, which of course is a consideration. But rather than go to the expense of bringing fresh loam from great distances, I would prefer to use ordinary garden soil.

Watering.—This, I often think, is the most important point in mushroom growing, especially under glass roofs, and where there is no foliage above to protect the beds from the rays of the sun. When I first began mushroom growing in the paths of my houses, this question of watering puzzled me greatly. My beds were continually getting dry, and I kept as continually watering them. I felt that all this was wrong; so, until I could think out a better plan, I covered my beds with a thin coating of clean straw all over, which answered fairly well, the straw preventing such rapid evaporation as took place before. There was, however, this to be said against it: first, that one could not see when the mushrooms made their first appearance on a newly formed bed, which we are anxious to do; secondly, when the mushrooms had to be gathered, there was always a great deal of trouble attached to the removal and replacement of the straw; and, thirdly, the straw proved to be an undoubted shelter for woodlice and slugs. After a little thought, I hit upon a plan which I at once adopted, and have had working for some years with very satisfactory results. I shall here attempt to describe it. The paths of the houses are, of course, excavated to the depth required for the reception of the dung, and lined on each side with brick walls, one brick thick. Fixed into these, at intervals of 6 feet, are crossbeams, 3 inches by 3 inches, and on the top of these, in the middle of the bed, and nailed to the cross pieces, runs a thick plank that will not spring. This is used as a gangway, or place to walk and wheel on. Lengths of wood of the same dimensions as the cross pieces are fixed on the top of the walls, running the whole length of the bed. On these are hinged shutters, made of wood, an inch in thickness, on each side of the gangway, and 6 feet long, or so that each shutter will catch on the crossbars for support when down, and so wide as to fit closely to the gangway, and the arrangement is complete.

For examination of the bed, watering, weeding, and gathering crop, all that is required is to raise a shutter where you please—by the way, they are all fitted with wooden handles, firmly secured—and set it back. It then stands upright, having for support the greater part of the thickness of the wall plate. When the examination is over, the shutters are gently laid back in their places, and all is darkness and comfort underneath.

This arrangement is a little expensive at first, but that is soon covered by the saving of labor and the greater comfort in working the beds. With this arrangement the workpeople can walk on the gangway and shutters over the whole surface of the beds in prosecuting the work of training vines or tomatoes as the case may be; whereas, with only a single plank running up the middle, slips of the feet were constantly occurring, much to the detriment of the mushrooms underneath.

After spawning and moulding, the beds are allowed, of course, to remain without water till nearly the end of the sixth week, when they receive a gentle sprinkling of tepid water daily till the moisture reaches the manure, after which the mushrooms soon appear. When this takes place, the boarding on top of the beds is kept wetted by the syringe three or four times a day, according to the weather, which has a wonderful effect in keeping the beds below in a uniform state of moisture.

I may mention that when I began to grow mushrooms first in my glasshouses, I had the bottoms of the beds concreted, but partial and sometimes total failure was the result. Judging the cause, I had the concrete removed, with good crops as a result.

In conclusion, I may state that my average yield of mushrooms per square foot of bed is about $1\frac{1}{4}$ lb., which yields a satisfactory profit.—*Market Gardener.*

THE MEDICINAL USES OF LEAVES.

By P. L. SIMMONDS, F.L.S.

IT is strange how assiduous and successful both civilized and savage man have been in utilizing for some economic purpose every portion of various plants. Roots, stems, barks, saps, and exudations, leaves, flowers, fruit, and seeds are alike applied to some useful employment; especially has this been the case in pharmacy and medicine. To take one branch of vegetation, the foliage of plants, what a curious investigation for study does it offer in the form, color, texture, and qualities of various leaves, and the employment of some for food, for dyeing and tanning, for textile manufacturing and other economic applications, and for their medicinal properties. It is the last division I propose to consider here. Through the vulgar error of undervaluing what is common, we are apt to pass leaves by as of little worth. A close scrutiny and careful examination would convince us of the economic importance of these foliose organs. Their dietetic uses are alone of great importance, if we consider merely culinary vegetables, tea, and tobacco.

In glancing through various botanical and medical works, I have jotted down the various leaves which have a medicinal or healing reputation, and the list becomes an extensive one. Not that all these have any established reputation, for only a small number are included or recognized in the various national pharmacopœias, but their employment points to some generally conceived opinion as to their useful properties.

I have not thought it necessary to arrange these under their genera and families, but merely note them as described, under the belief that some among them may be found worthy of closer attention.

The leaves of *Asteracantha longifolia* are used in India as a diuretic.

The foliage of the *Eucalypts* of Australia, especially *E. amygdalina, citriodora, globulus* and others, yields a large supply of an antiseptic volatile oil of excellent, lemon-like fragrance. Cigars made of the leaves have been recommended in asthma.

The leaves of *Pilocarpus Pinnatifolius* are famed as an agreeable, powerful, and quickly acting sudorific, and also recommended as a specific in diphtheria, as well as in typhoid fever.

The foliage of *Leonotis Leonorus* has some therapeutic properties; the leaves when used like tobacco are highly sternutative.

Matico, the dried leaves of *Artanthe elongata*, serves

as a powerful styptic and for other medicinal purposes.

The foliage of *Artemisia Abrotanum* is used in domestic medicine, and also as a condiment.

The leaves of *Hamamelis virginica* are renowned in the States for their medicinal properties.

The leaves of *cinnamon*, of the *camphor tree* and of *Tetranthera laurifolia* are used to make aromatic baths for persons suffering from rheumatism.

Bhang consists of the larger leaves and capsules of Indian hemp, which are used for making intoxicating drinks, and a sort of intoxicating conserve or confection, called *majoon*.

The betel leaf (*Chavica Betel*) acts as a powerful stimulant to the salivary glands and digestive organs. Its use is, therefore, conducive to health, and has been found to be an excellent preservative against scurvy in long sea voyages.

The fresh juice of the leaves of *Clerodendron viscosum* is used as a vermifuge, and also as a bitter tonic and febrifuge in malarious fevers.

The leaves of *Datura Stramonium* are applied to boils and ulcers, and are smoked with tobacco for asthma. Those of *Datura alba* and *D. fastuosa* act as anti-spasmodics.

The leaves of *Eupatorium Ayapana* have been employed for tea in the Mauritius, and the expressed juice from them is used internally as an astringent.

The leaves of *Sapindus Saponaria* are employed by the creoles in the Mauritius in constipation.

Buchu leaves are the produce of *Barosma betulina* or *crenata*. In trade this valuable drug is sometimes adulterated by the substitution of leaves of less powerful sorts of the same family of plants, which, although of a similar smell, are by no means equal to it in their therapeutical effects; 94,265 pounds of buchu leaves, valued at £1,307, were shipped from the Cape Colony in 1884.

By some authorities, *B. serratifolia*, Willdenow, is said to furnish the buchu leaves. *B. crenulata*, Hooker, is only a variety of this species. *Empleurum serrulatum*, Solander, also yields some, which are easily distinguished by the linear-lanceolate serrated leaves.

The leaves of the *Ferronia elephantum* are aromatic and carminative. In Mohammedan medical works they are described as astringent.

The fresh juice, diluted, of the leaves of *Ægle Marmelos* is largely used in Bengal as an antibilious and febrifuge, and also as a vehicle for other febrifuges. Made into poultices, it is used for treating ophthalmia.

The leaves of *Æschynomene Sesban* are much used in India as a poultice to promote absorption.

The viscid mucilage obtained from the fresh leaves of *Aloe indica* is also used by the natives as an excellent demulcent, especially in gonorrhœa.

The fresh leaves of *Cassia alata*, when bruised and mixed with lime juice, have been found to act with decided efficacy in ringworm and other similar affections of the skin. Made into a plaster, combined with sandal wood, the leaves of *Cassia Sophora* are used as a similar specific.

The dried leaves of several species of *Cassia* are largely used in the East, in combination with other drugs, for their purgative properties; and the leaflets constitute the senna of commerce. *Cassia acutifolia* furnishes part of the Alexandria senna; *C. angustfolia* yields Mecca and some of the Bombay senna; *C. obovata* some of the African senna, which is less esteemed and less collected than the other species. *C. elongata* produces several varieties of East Indian. *Cassia Absus* is also one of the sources of medicinal senna leaves.

A decoction or infusion of the leaves of *C. auriculata* is much esteemed as a cooling medicine by the Singhalese, and also as a substitute for tea.

The leaves of *C. Tora* are used as an aperient; both leaves and seed constitute a valuable remedy in skin diseases, chiefly ringworm and itch.

The pulp of the leaves of *Aloe vera* is in native practice applied to boils, and is regarded as acting powerfully on the uterus, and to be useful as an emmenagogue.

Dr. White states that the leaves and tops of *Artimisia vulgaris* are used in nervous and spasmodic affections connected with debility.

The leaves of *Hydrocotyle asiatica* have been made officinal in India. They are given in infusion to children in bowel complaints and fevers, and are described as alterative and tonic, and when locally applied, stimulant. They are used in leprosy with good results. In secondary or constitutional syphilis, they are of great value. In ulcers and skin diseases, they are prescribed both internally and externally. On the Coromandel coast, the leaves are applied to bruises.

The dried leaves of *Hyoscyamus niger* are anodyne, sedative, and antispasmodic. A preparation from the leaves is useful in nervous irritability, mental excitement, sleeplessness, and various other mental disorders.

The aromatic leaves of *Laurus nobilis* possess tonic and febrifugal properties and are in much request for various condiments.

The expressed juice of the leaves of *Eugenia Jambolana* is employed alone or in combination with other astringents in dysentery.

The leaves of *Ferula Narthex* possess sudorific and carminative properties.

The leaves of *Acacia Lebbek* are used for rheumatism in fomentations or baths.

The leaves and young shoots of *Persica vulgaris*, in infusion, are said to be stomachic and vermifugal.

An infusion of the leaves of *Caryophyllus aromaticus* is given as a carminative in disorders of the stomach and colic.

The leaves of *Vinca rosea* have been found useful in cholera, dysentery, and cutaneous diseases.

The leaves of *Ocimum gratissimum* are employed in aromatic baths; sometimes with tobacco leaves in rheumatic complaints and paralysis.

The leaves of *Faham* (*Angræcum fragrans*), made into a beverage, are considered pectoral and stomachic. Dried, they are smoked in cases of asthma.

The leaves of lemon grass, *Andropogon Schœnanthus*, also make a pleasant warm and diaphoretic infusion—a grateful drink in febrile affections.

The leaves of *Arctostaphylos glauca* are used medicinally; when chewed, they excite the flow of the saliva and give a peculiar, strongly astringent, slightly bitter taste afterward.

The leaves of *Larrea americana*, sometimes called the creosote bush, are highly esteemed in California by the natives as a tonic and corrective of the system. They are sticky, with a strongly scented gum or resin.

A decoction of the leaves of a species of *Melaleuca* is much used in China as a tonic.

The leaves of the *Guava* tree, *Psidium pomiferum*, in decoction, were considered a remedy in the time of cholera in the Mauritius against vomiting and diarrhœa.

The leaves of *Argyreia speciosa* are employed for headache.

Pari leaves (*Cissampelos Pareira*) are said to possess the virtue of congealing water.

The bruised leaves of *Saponaria officinalis* form a lather, which much resembles that of soap when agitated in the water, and is similarly efficacious in removing grease spots.

The leaves of *Erythroxylon Coca*, having been scorched and well dried, are used for chewing, mixed with a little lime. Taken in moderation, they have a most extraordinary effect as a nervous stimulant. There are many medicinal preparations made from coca leaves.

The leaves of the Baobab tree, *Adansonia digitata*, are eaten by the Africans with their food, and are said to restrain excessive perspiration. A strong decoction of the leaves of *Dodonæa salicifolia* is employed as a gargle, or injected in the throat.

The leaves of the plantain, *Musa paradisiaca*, are antiseptic, and heal old ulcers and putrefying sores.

A lotion of the leaves of *Sesamum indicum* is used as a hair wash by the Asiatics, and is supposed to promote the growth of the hair and to make it black. As the leaves contain a quantity of mucilage, they are employed in North America to make a demulcent drink for catarrh.

The leaves of *Cinnamonum Tamala* and *C. albiflorum* possess carminative and stomachic properties, and are much used as a condiment in India.

The leaves of *Caryodaphne densiflora* are gratefully aromatic, and are used in infusion like tea, against spasms of the bowels. There are many other aromatic leaves, which are used by cooks and confectioners for flavoring food. The leaves of *Premna integrifolia* are bitter and carminative, and rubbed along with pepper, are administered in India in colds and fevers.

The fresh juice of the leaves of *Rivinus communis* is used as an emetic in poisoning by opium and other narcotics, and in decoction or poultice may be used as a lactogogue.

The leaves of *Tamarindus indica*, crushed, with water, and expressed, yield an acid fluid, useful in bilious fever and some urinary complaints; made into a poultice, they are applied to reduce inflammatory swellings and to relieve pain.

The leaves of *Trichosanthes dioica* constitute a bitter tonic. In bilious fever, a decoction of the leaves, with coriander in equal parts, is given as a febrifuge and laxative.

The dried leaves of *Tylophora asthmatica* are emetic, diaphoretic, and expectorant, useful in overloaded states of the stomach and other cases requiring emetics. It has also been found useful in dysentery, catarrh, and other affections in which ipecacuanha has to be employed.

The leaves of *Vitex Negundo* are aromatic, tonic, and vermifuge, and given in decoction, with the addition of long pepper, in catarrhal fever, with heaviness of head and dullness of hearing. A pillow stuffed with the leaves is placed under the head to relieve headache. The juice of the leaves is applied to ulcers.

The bruised leaves and ground root of *Withania somnifera* are employed as a local application to carbuncles, ulcers and painful swellings.

The leaves of *Aristolochia indica* are famed as an alexipharmic.

The leaves of *Clematis mauritiana* applied to the skin serve as a blister, and are recommended in rheumatism, lumbago, and other affections of the skin.

The foliage of *Althæa officinalis* is much used for medicinal purposes in France. In the Mauritius the leaves of the *Waltheria indica*, also known as "Guimauve," are used for their mucilage.

An infusion of the leaves of *Zizyphus Jujuba* is a popular medicine in Mauritius in cases of asthma and oppression.

The leaves of *Psoralea glandulosa* are regarded as a powerful vermifuge and a good stomachic.

The leaves of *Cajanus striatus*, roasted and powdered, are a powerful diuretic, and are given in derangements of the stomach, colic, etc. The bruised leaves are effectual in hemorrhages.

The leaves of *Melia Azadirachta* are stimulant, and applied to ulcers and skin diseases of long standing. They are also used in the form of poultices, to disperse glandular tumors, and in the form of a pulp, in cases of pustular eruptions and small-pox. The leaves of another species, *M. Azedarach*, have similar properties, and are used internally and externally in leprosy and scrofula.

The juice of the tender leaves of *Nerium odorum* forms in India a remedy for ophthalmia. A decoction of the leaves is said to reduce swellings.

The juice of the leaves of *Ocimum Basilicum* forms an excellent nostrum for the cure of ringworm, and the bruised leaves for scorpion stings.

The mucilage of the fresh leaves and stems of *Pedalium Murex* is highly valued by the people of Southern India as a medicine in gonorrhœa and dysuria. The leaves have an odor of musk; when fresh and stirred in water, they render it mucilaginous. Buttermilk in India is often fraudulently thickened by the use of these leaves.

The leaves of *Ptychotes involucrata* are used by the natives of India as a condiment and also as a stomachic and carminative in flatulency and other similar diseases. Though of an unpleasant smell, the leaves are now and then used as a substitute for parsley by Europeans.

A decoction of the leaves of *Uncaria Gambir* is evaporated by fuel and solar heat, and contains a large percentage of tannin, hence it enters largely into commerce for dyeing and tanning.

The powder of the dried leaves of *Lygodium flexuosum* is used with alleged success as a powerful errhine in obstinate headache.

The juice of the fresh leaves of *Momordica Charantia*, mixed with warm water, has been successfully used as an anthelmintic.

The leaves of *Vitex trifolia* are considered useful as an external application to all rheumatic pains, sprains, etc. The powdered leaves have been given with success in cases of intermittent fevers.

The leaves of *Polanisia icosandra*, bruised and applied to the skin, act as a counter irritant, and in delicate constitutions, as a blister.

The leaves of *Erythrina indica* are used in cases of fever by the natives of India, and are sometimes applied externally, to disperse venereal buboes and relieve pains on the joints.

The leaves of species of *Euphorbia*, when warmed, are applied over the hypogastric region, and are said to promote the secretion of urine. The juice is used as a diuretic, and for relieving asthmatic attacks, and when warmed and dropped into the ear, has been found to give great relief in earache.

Although by no means complete, this enumeration of the medicinal uses of leaves may be interesting in some quarters.—*Amer. Jour. Pharm.*

EXPERIMENTS ON THE PREPARATION OF BOILED LINSEED OIL.

By FRANK H. THORP, S.B.

THE composition and properties of the drying oils have been but little studied. About twenty-five years ago, Mulder* took up this subject and published his observations. Within the last few years other chemists have investigated the subject, but the particular changes which take place in the so-called "boiling" of linseed oil have received little attention.

The drying of this oil is due to its oxidation, and the oxidation is greatly hastened by the "boiling." The drier, or substance added to the raw oil, partially oxidizes the oil during the boiling, and when a thin layer of the boiled oil is exposed to the air it rapidly hardens owing to the further oxidation of the oil. The drier dissolved in the oil acts, perhaps, as a carrier of oxygen from the air to the oil.

The driers most commonly used are litharge, pyrolusite, borate of manganese, and zinc white. Recently the oxalate of manganese has been proposed for this purpose.†

According to Mulder, some of the linoleic acid is converted to linoleic anhydride during the boiling. This anhydride is a tough, elastic body. At the same time, some of the metal of the drier forms a salt with the remainder of the acid, and this salt gives hardness to the varnish.

Hazura and Bauer ‡ find that the rate of oxidation, and consequent hardening of the oil, depends on the ratio of linoleic and linolenec acids present.

When linseed oil is oxidized, it undergoes very marked changes in its physical properties; the color becomes darker, the oil becomes more viscid, and there is an increase in weight, sometimes equaling eight per cent. Some carbon and hydrogen are also driven off. These changes occur also during the process of "boiling." According to Cloetz,‖ the carbon and hydrogen eliminated do not all pass off as carbonic acid and water, but partly as an irritating vapor resembling acrolein. He has shown that the glyceryl is destroyed.

A good varnish must be thin enough to apply with the brush, must dry without cracking and with rapidity, and give a clear, colorless film, which should be somewhat flexible. Oil varnishes give tougher films than volatile varnishes.

PREPARATION OF BOILED OILS.

The oil used was a very light yellow cold-pressed, raw, Calcutta linseed oil. The same quantity of oil, 50 c. c., was used in each experiment unless otherwise noted. The weight of 50 c. c. of this oil was found to be 45·7 grammes. The quantity of drier used in each case was noted.

The general process of boiling in each case was as follows.

The measured oil was heated in glass beakers of about 150 c. c. capacity, which were set in a pan of fine sand as closely as they would stand without touching. The sand bath was heated by gas burners beneath. Thus from four to six beakers were heated at one time. By the use of a sand bath, the temperature of the oil could be regulated better than by direct heating, and the danger of the taking fire of the oil was reduced. By raising the sand around the beakers to about one-half the depth of the oil, the whole mass could be very evenly heated. The oil was frequently stirred during the heating. In the course of the experiments it was found that the size of the beaker and the quantity of oil used had a marked influence on the temperature. With a beaker of 250 c. c. capacity and containing 100 c. c. of oil, the temperature was found to be about 30° higher than in a beaker of 150 c. c. capacity containing 50 c. c. of oil, under similar conditions. The temperature in the larger beaker was also much more even.

As the presence of small quantities of water in the driers caused violent ebullition and frothing when they were added to the hot oil, they were carefully dried before being stirred into the hot oil. In those cases where the drier was added to the cold oil and slowly heated with the oil, it was seldom dried, as all water escaped before the oil was hot enough to froth or spatter. But salts with "water of crystallization" always caused some disturbance, since this water does not escape until the temperature is quite high. With clear raw oil there is no ebullition until a very high temperature is reached. At 220° small bubbles begin to show around the edge of the oil surface, and white irritating vapors of very disagreeable odor begin to come off. But active boiling of the oil does not take place under 360°, which was as hot as these oils were in any case heated. In general, the best results were obtained with temperatures between 230° and 275°.

LEAD SALTS.

Litharge.—Six experiments were made with quantities of litharge, varying from one-half of one per cent. to two per cent. of the weight of the oil, and temperatures varying from 220° to 300°. Two of these experiments yielded fairly good boiled oils. The first was

* Die Chemie der austrocknenden Oele, Berlin, 1867.

† Castelos, Bull. de la Soc. Chemique, vol. l., pp. 597, 645.

‡ Monatsch., vol. ix., p. 459.

‖ Bull. de la Soc. Chemique, vol. iii., p. 41.

DRYING TESTS.

Dryer.	Quantity of Dryer used.	Time of Boiling.	Time required for Drying.	Character of the Film.
	Grams.	Hours.	Hours.	
Litharge	1.0	2¼	6	Almost colorless.
"	0.2	2¼	10	" "
"	0.8	1½	10	
Lead peroxide	1.072	1½	Several days.	Deeply colored.
Lead chloride	1.247	2½	24	Somewhat colored.
Red lead	1.024	2½	24	Deeply colored.
Lead oxalate	1.323	2¼	Did not dry.	
" tartrate	1.6	2¼	24	Deeply colored.
" acetate	1.46	2¼	12	Somewhat colored.
" borate	1.105	1½	20	Slightly colored.
" carbonate	1.197	2	10	" "
Zinc oxide	0.5	2¼	45	Nearly colorless.
" sulphate	1.987	2½	45	" "
" sulphate	1.5	2½	45	Yellow in color.
" acetate	1.0	2¼	40	Colorless.
" borate	1.0	2	40	Nearly colorless.
" "	0.5	1½	46	" "
" "	0.5	1½	46	" "
" citrate	1.5	2½	36	" "
Manganese acetate	1.0	2¼	20	Nearly colorless.
" borate	1.625	2¼	20	Colorless and hard.
" sulphate	1.72	2	40	Colorless.
" oxalate	1.64	2	40	"
" acetate	0.5	2	20	Deeply colored.
" borate	0.5	1	20	Colorless.
" acetate	0.5	1¼	20	"
" oxalate	1.5	2½	36	"
" sulphate	1.5	2½	36	"
" oxalate	1.0	2¼	48	Yellow in color.
" citrate	1.5	1½	24	Dark colored.
" tartrate	1.0	2½	24	Colorless.
" formate	1.0	1	24	Somewhat colored.

made with one per cent. of litharge and at a temperature of 250° for two and one-quarter hours; the second, with about two per cent. of litharge and at a temperature of 220° for one and a half hours. The remaining four experiments did not give good boiled oils.

Lead Peroxide.—One experiment only was made, at a temperature of 220°, but the resulting oil was worthless on account of its exceedingly dark color.

Red Lead.—Two experiments, at temperatures from 220° to 285°, gave unfavorable results.

Lead Carbonate.—Three experiments, with about one per cent. of carbonate in each, and temperatures from 225° to 250°, were made. One, in which the temperature was kept at 225° for two hours, gave a fairly good boiled oil; the others were worthless.

Lead Nitrate.—One experiment, with two and one-half per cent. of nitrate and a temperature of 250°, resulted in a worthless mass of tar.

Lead Sulphate.—One experiment, with about two and one-half per cent. of sulphate and a temperature raised to 300° for nearly two hours, produced a very thin, turbid oil, of no value. The sulphate did not decompose, even at this high temperature.

Lead Chloride.—Three experiments were made with the chloride, the quantities used varying from one to two and one quarter per cent., and the temperature from 250° to 360°. The first, with two and one quarter per cent. of chloride and a very high temperature for one and three quarter hours, yielded a very sticky and elastic gum-like mass. In the other two cases, with lower temperatures, there appeared to be but little action on the oil.

Lead Oxalate.—One experiment, with about two and one-quarter per cent. of oxalate and a temperature at one time over 300°, yielded a thin and turbid oil of no value. Apparently the salt did not decompose. The oil did not dry.

Lead Acetate.—One experiment, with three per cent. of acetate and a temperature of 300°, gave a very dark-colored oil which dried very slowly.

Lead Borate.—Two experiments, with about two per cent. of borate and temperatures of 220° and 300° respectively, were made. The first gave a dark brown oil, and the other a dark reddish-brown oil. Both oils were quite fluid.

Lead Tartrate.—One experiment, with about two and one-half per cent. of the salt and a temperature of 270°, was made. The tartrate did not decompose until a high temperature was reached, and the boiled oil was very dark-colored and viscid.

Mixtures.—Two experiments with mixtures of litharge and red lead were made. Two per cent. of each oxide was used, and the temperatures kept below 250° in one case and 230° in the other. The boiled oils were quite fluid, but very dark colored.

Two experiments with mixtures of litharge and acetate were made, using two per cent. of each and keeping the temperatures as in the above cases. The results were better with these, although the oils were quite deeply colored.

ZINC SALTS.

Zinc Oxide.—Two experiments, with one and two per cent. of oxide respectively, and the temperature at 250°, were made; both gave turbid oils which did not clarify satisfactorily. The colors were light brown. These oils dried very slowly.

Zinc Sulphate.—Two experiments were made with this salt, using nearly four per cent. in one case and three per cent. in the other. In the latter case the sulphate was added to the cold oil and heated with it. The temperature in this case was raised to 285°. The oil was poor. In the former case the temperature was kept below 230°. The oil was light red in color, and the sulphate appeared to have very little action.

Zinc Carbonate.—One experiment, with three per cent. of the salt and a temperature of not over 280°, gave a poor result. It was, in fact, much like the oxide.

Zinc Acetate.—Two experiments, with two and four per cent. of acetate and temperatures between 235° and 280°, gave red oils, which were clear and fluid, but slow drying.

Zinc Chloride.—One experiment with this salt resulted very similarly to the first lead chloride experiment. A semi-solid mass was formed.

Zinc Borate.—Three experiments, with two per cent. of the salt and a temperature not over 240°, gave fluid dark red oils, which dried slowly.

Zinc Oxalate.—One experiment showed that the oxalate did not act on the oil after prolonged heating at 260°; on raising the temperature to 300°, the oil was converted into a mass of tar.

Zinc Citrate.—One experiment, with three per cent. of the salt and the temperature at 230°, gave a fairly good, clear oil, which dried rather more rapidly than the oils prepared with the other zinc salts.

Zinc Tartrate.—One experiment, with three per cent. of the salt and a temperature of 300° was made, but the salt appeared to have very little action upon the oil.

MANGANESE SALTS.

Manganese Binoxide.—One experiment, with one per cent. of the oxide and a temperature not over 220°, gave a very dark colored boiled oil.

Manganese Carbonate.—One experiment with this salt, at a temperature not over 250°, gave a reddish-brown boiled oil, much like the best oils obtained with litharge.

Manganese Acetate.—Three experiments, with quantities of the salt from one to two per cent. and temperatures from 225° to 250°, gave red boiled oils of varying depth of color. All dried quickly and were good boiled oils.

Manganese Borate.—Two experiments, with one and three per cent. respectively of this salt and temperatures of 280° and 220°, gave the best oils obtained in the entire investigation. The boiled oils were clear, fluid, and light colored. They dried quickly and gave good films.

Manganese Sulphate.—Three experiments, with from two to about three per cent. of this salt and temperatures from 240° to 300°, gave varying results. At 300° the sulphate decomposed rapidly, and tarred the oil; at the low temperatures there was less action, and good clear oils were obtained.

Manganese Oxalate.—Five experiments, with from one to three per cent. of the salt and temperatures from 230° to 315°, gave rather unsatisfactory results. At the lower temperatures the oxalate did not appear to decompose, and the oils were turbid from sediment, which did not settle on long standing. These oils were light in color, but dried rather slowly. At the high temperatures there may have been some decomposition of the salt, but the oils obtained were also turbid, and, in one case, quite dark colored.

Manganese Citrate.—One experiment, with three per cent. of the salt and the temperature at 230°, gave a very dark-colored oil.

Manganese Tartrate.—Two experiments, with from two to three per cent. of tartrate and temperatures from 230° to 260°, were made. The first gave a very good oil; the other did not.

Manganese Formate.—Two experiments were made with this salt. In the first, two per cent. of the salt was used, and the oil was converted into tar. In the second, one per cent. of salt was used and the temperature kept below 200°, the time of heating being about one hour. The boiled oil obtained dried very fast, but was very dark brown in color. The result was not good.

Small plates of glass were used for these tests. These were coated with a film of the oil, and were then placed in a light room to dry. The temperature of this room varied somewhat, but was commonly about 70° F. during the day. Generally from a dozen to twenty samples were tested at a time. The films were considered to be dry when they could be handled without leaving finger marks upon them. The plates were examined at intervals of several hours, and only relative results as to the time of drying were expected. The chief points looked for were the color and hardness of the film. The results are given in brief in the foregoing table.

EXAMINATION OF THE BOILED OILS.

The analyses given below were made in the hope of throwing some light upon the relation between the quantity of drier dissolved and the rate of hardening of the oil.

For the determination of the lead the following method was used. A weighed amount of oil was carbonized in a small evaporating dish, and then ignited over a Bunsen lamp until all the carbon was burned off. The residue was digested with hot dilute nitric acid, and filtered. The lead was then precipitated as sulphate, with the usual precautions, and weighed. The following results were obtained:

Boiled Oil.	Quantity of Dryer added.	Per cent of Metallic Lead in the Boiled Oil.		
		Calculated.*	Found.	
	Grams.		I.	II.
Lead carbonate	1.197	2.03	1.392	1.477
Lead acetate	1.466	2.23	1.396	1.338
Litharge	0.2	0.406	0.244	—
Lead borate	1.105	2.03	0.982	0.998

From the drying tests it will be seen that the first two oils in the above table dried in nearly the same time, and gave very similar results. But the third oil dried in half the time required for the fourth, although the latter contains more lead.

In the determinations of manganese in the oils, the following method was used. The oil was weighed and charred in an evaporator. It was then ignited over a Bunsen lamp until all the carbon was burned off. The residue was digested with dilute hydrochloric acid and heated nearly to boiling, filtered, and neutralized with ammonia. Some ammonium chloride was then added, and then an excess of sodium phosphate. The precipitate was filtered off, dissolved in hydrochloric acid, avoiding an excess of acid, and the solution heated to boiling.

Ammonia was then slowly added to the boiling solution until a large excess was present. The precipitate was boiled, without filtering, for ten minutes, to convert the phosphate of manganese to a scaly form, and was kept hot for about one hour longer. It was then filtered off, washed with dilute ammonia, ignited to the pyrophosphate, and weighed. The following results were obtained:

Boiled Oil.	Quantity of Dryer added.	Per cent of Metallic Manganese in the Boiled Oils.		
		Calculated.†	Found.	
	Grams.		I.	II.
Manganese sulphate	1.72	1.37	.045	.038
Manganese borate	1.62	2.06	.208	.190
Manganese acetate	0.5	0.347	.248	.256
Manganese oxalate	1.5	1.034	—	.030
Manganese tartrate	1.5	0.670	.049	.043

From the drying tests it will be seen that the first and fourth oils above analyzed dried very slowly, while the

* The quantities in this column are the calculated per cents. of metallic lead which the boiled oil would have contained if all the salt added to the raw oil had been dissolved in the boiled oil. But in no cases was the drier entirely dissolved in the oil, a sediment of undecomposed salt of greater or less quantity always settling on the bottom of the bottles upon standing several days. Only the clear oil from the upper part of the bottle was used for these analyses.

† See note to the preceding table.

last one, with about the same quantity of manganese, dried in about one-half the time required for the first and fourth.

CONCLUSIONS.

Lead driers always give the oil a deep color, which shows more or less in the film.

Zinc driers do not appear to act on the oil to any great degree, as oils thus prepared dry slowly and do not give very hard films.

Manganese driers give the best results in all respects. Litharge gives the best results of the lead driers, the oil being quick drying and the film hard, and, if not overheated, the oil is but moderately colored. Of the zinc salts, the acetate seemed to give the best result, although the borate and citrate were nearly as good. The borate and acetate of manganese gave the best results obtained. The acetate requires careful use, for, if heated much above 330°, it gives a deep color to the oil, owing apparently to the formation of tar. The borate undoubtedly gives the best boiled oil for all purposes.

The oxalate is difficult to decompose, or at least has little or no action on the oil until a very high temperature is reached. In two experiments the quantities of borate and oxalate used and the temperatures of each were nearly the same, but the borate gave a good oil, while the oxalate did not.

The chlorides, nitrates, and sulphates do not make good driers. The first two have too violent an action on the oil, while the last are very difficult to decompose, requiring a high temperature.

There appears to be no advantage in the use of formates, citrates, or tartrates. The first two are apt to produce much tar, and the last are difficult to decompose.

No very definite conclusions can be drawn as to the relation between the quantity of drier dissolved and the rate of drying of the oil. From the few analyses made there would appear to be some relation here; but in two cases, lead borate and manganese tartrate, exceptions were found. The lead borate gave an oil drying much more slowly than was to be expected, while the manganese tartrate oil dried with comparative rapidity. The quantity of manganese dissolved appears to be much less than the quantity of lead taken from lead driers. Two-tenths of one per cent. of manganese appears to give a good drying oil, while about one per cent. of lead occurs in the best drying oils.

DETECTIVE PHOTOGRAPHY.

By J. C. HANNYNGTON, Madras.

To detect or identify the lad who purloins your fruit while you are absent at morning service is simple work.

The camera, in some unobtrusive form, is concealed in a position which commands the approach to the forbidden fruit; the shutter (a simple drop) is kept fixed for action by a wedge, which wedge is attached to a hair line (a single thread of a woman's hair will suffice) which is stretched across the path along which the approach to the tree must be made.

As the thief walks along the path he touches the line, the shutter is released, and the exposure made. When it is desired, however, to secure a photograph of any person or animal which may pass along a given path by night in the dark, the procedure is more complicated.

The camera commanding the approach must be placed as above described. If it is certain from which direction the approach will take place, one camera will suffice; but if the direction of approach is uncertain, two cameras may be necessary to secure a front view of the subject.

It will be necessary to secure the picture by a flash light, and the conditions required are that the lens shall be uncapped at the moment the flash takes place, and at the moment the subject reaches a given point within the range and focus of the lens. It will not do to leave the lens open all night, lest it should be frosted by dew or exposed to the morning light.

It is easy to arrange a line and trigger on any path, so that any creature passing along the path will pull or release the trigger, and the trigger may be made to fire a gun, explode a mine, or fire a flash light of any kind.

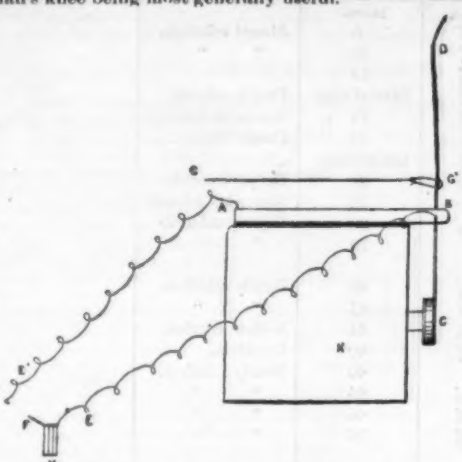
The following method is simple and effective, and may be varied according to the ingenuity of the operator. On the top of a camera, K, or preferably detached from it, is fixed a rod of wood, A B, with a pivot at B, upon which a lever, D C, carrying the lens cap at C, swings easily. The lever, C D, is of metal, and is placed in electric communication with one pole of a battery, H, by the wire, E. The wooden rod, A B, carries at the end, A, a metal point or bar which is in electric communication with the other pole of the battery through the wire, A E'. When the lever, C D, is depressed so that the metal thereof at D touches the point or bar, A, the circuit of the battery is completed, and a fine platinum wire at any interval, F, in the wires, E E', will be made red hot.

There may be any number of intervals, F, each being constructed of fine platinum wire, and if the battery be of sufficient intensity, the wires at all the intervals will be simultaneously and instantly heated. The lever, C D, is so arranged that when in its normal position the weight of the cap, C, will keep the cap, C', entirely over the lens of the camera, and so completely exclude all light or damp from the lens. G G' represents a line of hair, cord or wire, having at the end, G', a loop which passes over the lever, C D.

If the line, G G', is pulled back, it depresses the end, D, of the lever, C D, and raises the cap, C, until the lens is wholly uncovered, and finally the end of the lever, D C, will come in contact with the point, A, the electric circuit will be completed, and the wires at the intervals, F, will be heated. The line, G G', is extended round trees, or in any convenient manner, until it crosses the route by which the subject to be photographed will pass, and is then made just taut, and fastened securely.

It is clear that any person or animal passing along the route and coming in contact with the line must stretch the line so that the loop, G', must go back, carrying with it the lever, C D, until the electric contact is made.

Immediately subsequent to this the loop, G', is carried over the end, D, of the lever, and the cap, C, swings back by gravity, and recovers the lens securely. At the intervals, F, are placed, on the platinum wires, charges of gun cotton and magnesium powder, or any other form of flash light which may be preferred, and, as these charges are fired while the lens is fully uncapped, a photograph can be taken. The height of the line should be adapted to the subject, the height of a man's knee being most generally useful.



The charges and intervals should be so arranged that the light of the flashes, while fully illuminating the subject, do not strike on the lens of the camera. The system of laying the detector line is merely a modification of the method of setting alarm guns, in every day use for poachers.

In practice it will be found necessary to pass the line, G G', through a loop somewhat below the level of the wooden bar, A B, as otherwise the lever, C D, will not be sufficiently depressed.—*Photo. News.*

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